September 1975
Volume 19
Number 5

Mariners Weather Log

National Oceanic and Atmospheric Administration • Environmental Data Service

Mariners Weather Log

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September 1975
Volume 19 Number 5
Washington, D.C.

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Cover: The BRITISH AMBASSADOR's lifeboat approaches the FORT FETTERMAN in a dramatic rescue hampered by rough seas. For complete story, see item "Saving Lives in the Pacific," on page 294. Photo courtesy of the Military Sealift Command.

Back Cover: This photo shows only two of the three freighters that are high and dry at Gulfport, Miss., as a result of hurricane Camille's storm surge. Project STORMFURY, described on page 269, is an experiment that will determine whether hurricanes can be beneficially modified and thus lessen damage along our coastline.

Mariners Weather Log

PROJECT STORMFURY

Hurricanes – Can Their Destructive Force Be Reduced?

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Project STORMFURY was formed in 1962 as a cooperative venture of the Department of Commerce and the Department of Defense. Its objective is to investigate ways for man to alter tropical cyclones beneficially. The organization has changed during the past few years, and the project is now basically a NOAA program.

The general name of the family of storms which includes hurricanes is tropical cyclones. Members of this family are called tropical depressions, tropical storms, cyclones, hurricanes, and typhoons, depending on their strength and location. These storms are convectively driven low-pressure systems whose winds flow counterclockwise around the storm in the Northern Hemisphere and clockwise in the Southern Hemisphere. Their windspeeds generally increase inward toward the storm center. In relatively mature storms, a band of clouds is formed, called the eyewall, which encircles the center of the circulation, with an average radius of 10 to 15 mi from the storm center. The windspeeds usually reach their maximum strength in the region of the eyewall and become relatively calm in the nearly cloud-free eye. These maximum windspeeds can exceed 175 kn. The center of a mature storm, especially at middle and upper levels, is much warmer, and has a much lower surface pressure, than the exterior portions. Figure 1 shows an artist's conception of a hurricane with a pie-shaped section cut

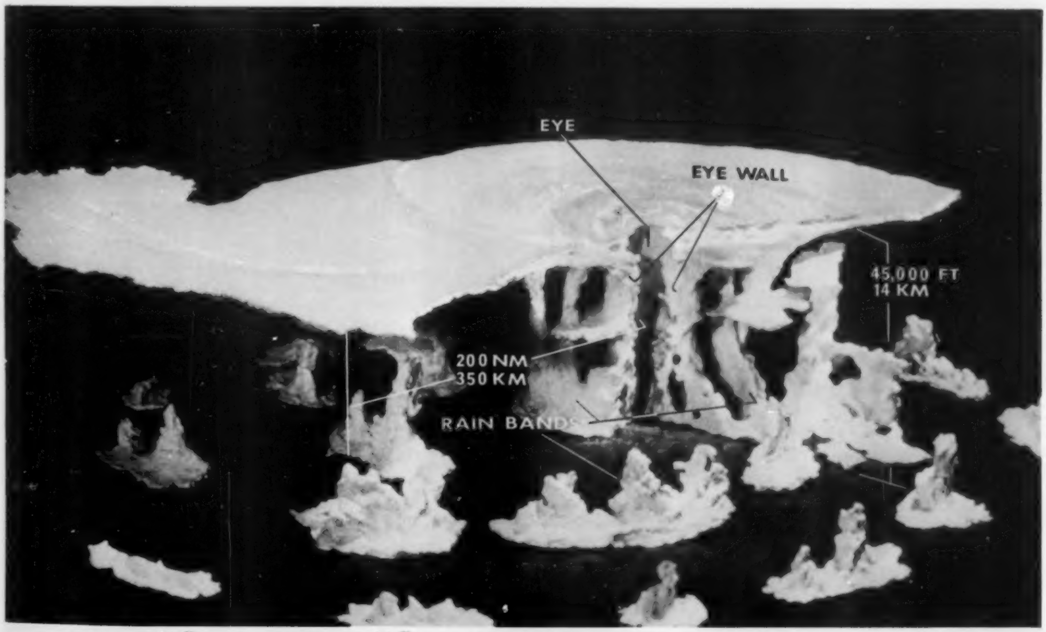

Figure 1.--An artist's conception of a hurricane. A pie-shaped section has been cut away all the way into the eye. The vertical scale has been enlarged by about a factor of 10 compared to the horizontal scale. The eye, rainbands, and cirrus shield are illustrated.

away all the way into the eye.

The losses caused by a single hurricane, typhoon, or cyclone can be large enough to determine the success or failure of some nation's economy. The average annual cost of hurricane damage to the United States alone is now about $450 million. Hurricanes Betsy (1965) and Camille (1969) caused more than $1.4 billion damage each (Gentry, 1974). The loss of property, of course, is only part of the picture. Other losses, such as loss of business, increased material and food costs due to a loss of productivity, increased shipping costs, etc., would increase these numbers to even greater proportions. These factors do nto include the loss of human life.

The damages resulting from hurricanes are basically caused by the wind, storm surge, and rainfall.

Figure 2.--Scenes of the Trinity Episcopal Church, built in 1849 in Christian, Miss., before (top) and after (bottom) the passage of hurricane Camille (1969). These pictures and figure 3 (opposite page) illustrate damage from Camille where several people lost their lives despite the presence of shelters and adequate warnings. Photo courtesy of Chauncey Hinman.

Nearly all storms which make landfall cause damage from each of these three factors. However, the relative percentage of damage for each factor varies widely, depending upon the storm and where it comes ashore. For instance, the damage resulting along the Texas coast from hurricane Celia (1970) exceeded $450 million and was mostly caused by wind (Gentry, 1974). On the other hand, the storm surge along the Gulf Coast during the passage of hurricane Camille in 1969 reached 25 ft (7.6 m) in some locations (Simpson et al., 1970) and accounted for much of the damage (figs. 2 and 3). Finally, the torrential rains associated with hurricane Fifi (1974) caused inland floods and mudslides in Honduras resulting in the deaths of from 3,000 to 10,000 people (Hope, 1975).

The strength of the storm, its speed and direction of movement, and its associated rainfall pattern, all play important roles in determining the damage caused by a given storm. The rainfall and storm-surge height are dependent upon the strength of the storm, its speed of movement, and the local topography, including the ocean bottom near the coast. The resulting damage is dependent upon these factors, the types of structures, and the preparedness of the local residents.

Tropical cyclone damage could be reduced with the proper alteration of the listed storm parameters. Only alterations of the strength of the storm are considered possible in the near future. These alterations

Figure 3.--Scenes of an apartment house along the Gulf coast of Missippi before (top) and after (bottom) the passage of hurricane Camille. Photo courtesy of Chauncey Hinman.

would, of course, change the windspeed and possibly the storm surge, but should have no significant effect upon the rainfall.

Project STORMFURY experiments are designed to alter the balance of forces in the region surrounding the eye of the tropical cyclone, thus causing a redistribution of the energy concentrated near the storm's center. A tropical cyclone draws most of its energy from latent heat released during the convective overturning of the atmosphere. At low levels, warm moist air spirals over the tropical sea toward the storm's center carrying copious quantities of latent and sensible heat. As this air flows into the storm, it acquires some additional energy from the ocean. Most of this air flows upward through the eyewall and/or into the surrounding rainband clouds. The inflowing air releases latent heat by forming water droplets and ice particles in the clouds, and thus furnishes most of the energy for driving the storm. The air, slowly turning as a result of the rotation of the Earth, gathers tangential speed through partial conservation of its absolute angular momentum during its slow inward spiral. This process produces stronger and stronger winds as the air gets closer and closer to the storm's center, until the air flows upward and then away from the storm's core at high levels. A process which would cause this low-level, moisture-laden air to rise at a greater distance from the storm center than would naturally occur would produce a reduction in the windspeeds. It would also cause a change in the thermal structure of the storm, since there would be an increase in the rate of latent heat release in the new region of ascending air motion and a decrease in the region where the air formerly rose. The question then is how to alter the mass flow in the hurricane.

Radar observations in hurricanes containing a well-formed eyewall indicate that many of the areas located outward from the eyewall, away from the storm center, contain clouds that do not extend to the outflow level. Other observations indicate that most of these clouds contain large quantities of supercooled liquid water (water with a temperature colder than 0°C). Numerical calculations based upon buoyancy indicate that these clouds can be caused to grow through the dynamic seeding process. Injection of silver iodide particles (which appear to the cloud to be ice particles) into these clouds causes the droplets to freeze, releasing the latent heat of fusion (~80 cal/g). This additional heat increases the buoyancy of that portion of the cloud (causes that portion of the cloud to be warmer, and therefore lighter, than the surrounding air) and thus triggers an increase in the ascending flow. As the air rises, it expands and cools, and water vapor condenses or sublimates (forms water droplets or ice particles), releasing considerably more latent heat (~600 cal/g). The result is that the seeded clouds grow to the outflow level and thus provide new convective conduits which intercept the inflowing moisture-laden air near the surface, causing it to rise to the outflow layer and be carried away from the core of the storm. This increased heating in the seeded clouds on the exterior edge of the eyewall, along with the decreased fuel supply for the old eyewall, also results in diminished horizontal temperature gradients. The reduction in windspeeds follows naturally from this sequence of events. That is, air flowing inward and accelerating because of the partial conservation of angular momentum ascends in this new convective area before it reaches the tangential speeds that it would have achieved had it continued to spiral into the old eyewall.

In summary, the STORMFURY hypothesis is:

a. Clouds are seeded outward (away from the storm center) from the external edge of a mature hurricane eyewall.
b. The supercooled water in the seeded cloud freezes, latent heat of fusion is released, the buoyancy of the upper portion of the cloud increases, and increased ascent results in increased condensation rates and cloud growth.
c. The seeded cloud reaches the outflow level, providing a conduit for the major vertical mass transport at a larger radius.
d. The old eyewall circulation weakens as the vertical mass transport is concentrated in the seeded clouds, and the subsidence in the eye decreases.
e. The maximum windspeeds are reduced due to the partial conservation of angular momentum and the decreased temperature gradients.
f. The pressure field adjusts to the wind and temperature fields.
g. Finally, the storm starts to return to its natural state, as determined by the synoptic scale environment (atmospheric and oceanic conditions surrounding the hurricane), 6 to 18 hr after the final seeding.

The process just described is schematically illustrated in figure 4, which shows a vertical cross-section through the center of a storm. The upper panel shows the storm prior to seeding, and the lower panel illustrates the hypothesized alterations in the translational flow and cloud structure.

The hurricane modification research, including simulations by numerical models, and the field experiments conducted in previous years suggest that the maximum winds in hurricanes can be reduced by 10 to 20 percent when the proper clouds of the storms are seeded with freezing nuclei. This doesn't sound

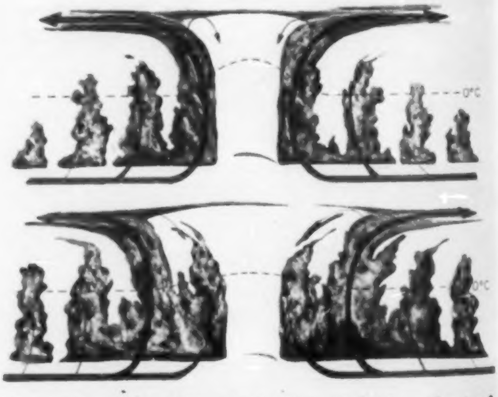

Figure 4.--Schematic illustration of the hypothesized convective structure and translational flow through a storm before (top) and after (bottom) the seeding effect starts taking place.

like much of an effect. However, the force of the wind varies with the square of the windspeed; therefore, a reduction of 10 to 20 percent in the maximum windspeeds will result in a reduction of 19 to 36 percent in the maximum force of the winds. The wind damage could be reduced by at least an equal amount. Research relating damage to windspeed suggests that the damage would be reduced by an even higher percentage. The storm surge is a function of several parameters, but the principal influences are the sustained windspeed and the slope of the ocean's bottom. This suggests that, in most cases, reducing the maximum windspeeds should also reduce the storm surge. Therefore, if the maximum surface windspeeds can be reduced by only 10 to 15 percent, the hurricane damage in the United States could be reduced by $50 to $100 million per year, and lives might be saved in areas that are difficult to evacuate.

Four hurricanes have been seeded since 1961 (fig. 5): hurricane Esther (1961), hurricane Beulah (1963), hurricane Debbie (1969), and hurricane Ginger (1971). All of these cases except Ginger involved seeding in or near the eyewall. In all but one of these cases, there were indications of a reduction in windspeed. In no case was there an indication of a windspeed increase. However, only the two hurricane Debbie experiments were conducted in a manner closely resembling the present STORMFURY hypothesis. The hurricane Ginger rain sector seeding experiments, on September 26 and 28, 1971, were performed on a poorly defined, diffuse storm. This makes direct comparison with results obtained in hurricane Debbie impossible, although some modifications to the clouds in Ginger did occur as a result of the seeding.

Hurricane Debbie (1969) was seeded five times each on 2 different days (fig. 5). The maximum windspeeds decreased by approximately 30 percent on August 18, and 15 percent on August 20 (figs. 6 and 7). There is evidence other than the windspeed alone that supports the present STORMFURY hypothesis. In fact, the present hypothesis is partially based upon the analysis of the Debbie experiments. For instance, there was a decrease in the middle-level temperature in the eye of Debbie on both the 18th and 20th, and indications of slight increases in temperature outside the eyewall. Also, the water vapor content in the eye

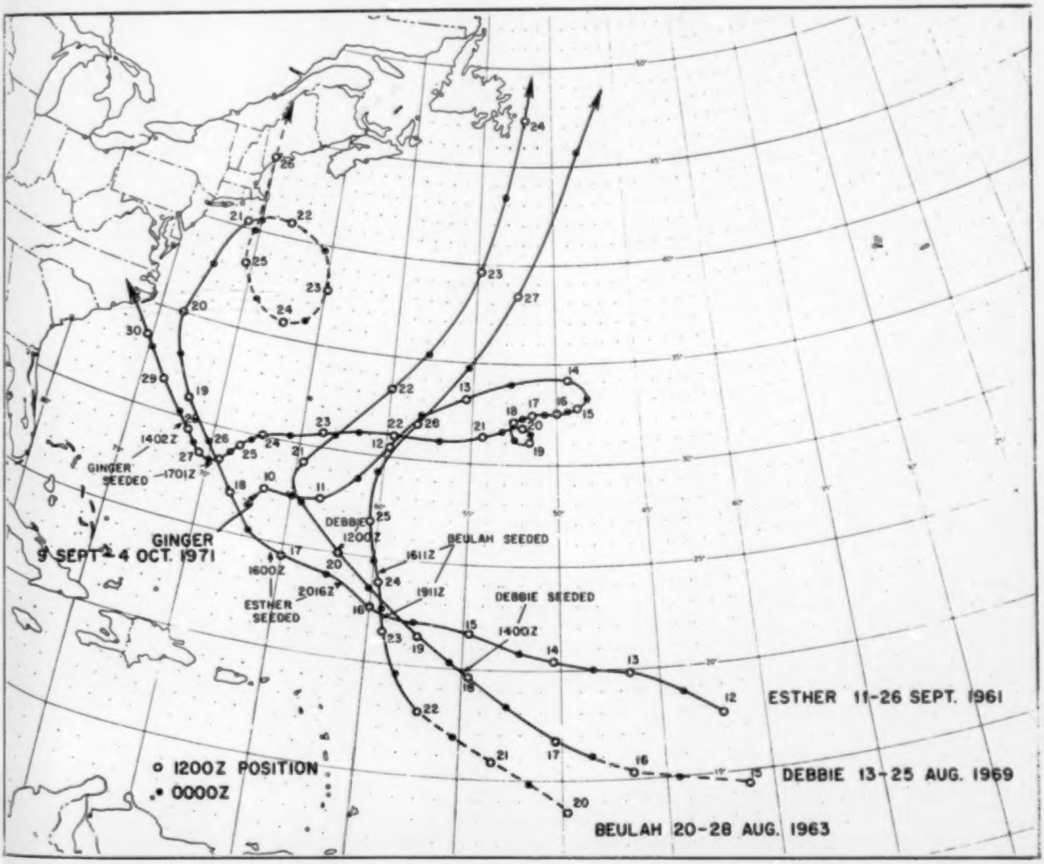

Figure 5.--Tracks of all hurricanes which have been seeded from 1961 to 1975. (Times and locations of seedings are indicated.)

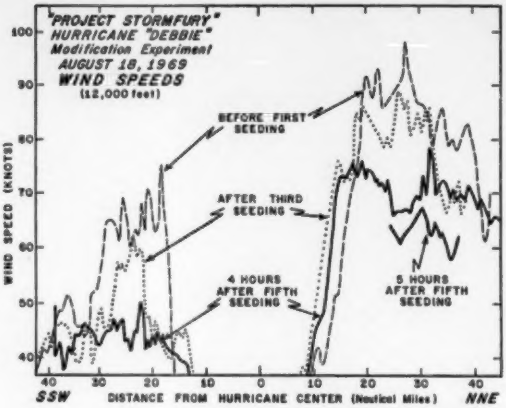

Figure 6. -- Hurricane Debbie windspeed profiles recorded on August 18, 1969 (after Gentry, 1970).

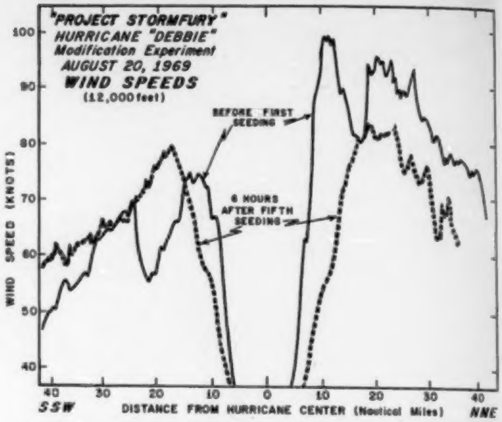

Figure 7. -- Hurricane Debbie windspeed profiles recorded on August 20, 1969 (after Gentry, 1970).

at these same levels increased considerably on both days, possibly indicating a weakening of the circulation set up by the old eyewall. There was also other evidence as depicted by the changing structure of the storm (Sheets, 1973) and in the radar structure (Black et al., 1972). In summary, although not conclusive, time sequences of the wind, radar, and other data suggest that a modification to hurricane Debbie was achieved. However, more such data analyses are required before definitive statistical support can be claimed.

The progress of the experimental program and research has continually undergone scientific scrutiny, and periodic symposia have been held. An Advisory Panel consisting of five members from the scientific community provided guidance from 1962 to 1973 on the scientific and technical aspects of the project, and a workshop was conducted in 1974 which involved many prominent scientists in the field of meteorology. These groups recommended increased emphasis on cloud physics, radar, the sequence-of-events approach, and the physical analysis (reasoning from cause to effect). The results of the Debbie experiments were so encouraging that increased efforts were urged toward the testing of the STORMFURY hypothesis. Also, new instrumentation was being developed which would permit a thorough evaluation of each link in the hypothesis.

To test the STORMFURY hypothesis thoroughly, certain critical variables should be measured to determine the following:

a. Variations with time of wind, temperature, pressure, and radar echo patterns at various levels and positions, over periods of 12 to 30 hr, in both natural and seeded tropical cyclones.
b. Availability and extent of potential energy in the form of supercooled water, the distribution of nuclei after seeding, and the effectiveness of conversion to ice.
c. Variations of sea-surface temperature and momentum flux, the inflow of latent heat in the subcloud layer and other levels of tropical cyclones, and the modification of these parameters due to seeding.
d. Large-scale circulations in the upper troposphere that act to maintain or to inhibit the hurricane.
e. Surface wind and wave fields, the wave-coupled momentum flux and its relation to total momentum flux, surge damage potential, and the role of surface waves in the ocean-atmosphere feedback system.
f. Effects of a tropical cyclone on mixing and upwelling of the ocean, and therefore on the sea-surface temperature, and the role of a modified ocean on the dynamics of the cyclone.
g. Parameters of sea-state wave spectra, surface wind, and sea-surface temperature that may be measured from aircraft using remote-sensing instrumentation.

The probable STORMFURY aircraft employment timetable illustrated in figure 8 should provide the required measurements. This diagram contains inserts illustrating the number of aircraft and crews required, as well as the basic monitoring pattern superimposed upon a simulated radar presentation. The periods of monitoring by each aircraft are indicated by blocks. The small illustrations directly above or below these blocks depict the portion of the basic monitoring pattern covered during that time period.

The goal is to establish a modification hypothesis at a confidence level high enough that the technique can be taken from the experimental stage and used operationally. The attainment of this goal will require monitoring of several seeded and unseeded cases. The likelihood of obtaining a sufficient number of experiments in the near future in the Atlantic is small. Therefore, plans are underway to operate from Guam in the western North Pacific (fig. 9), where it should be possible to obtain approximately five seeded and six unseeded cases each year, during the peak typhoon periods of 1977 and 1978.

Three major questions are raised concerning the effects of the modification upon the storm:

a. What is the chance of increasing the strength of

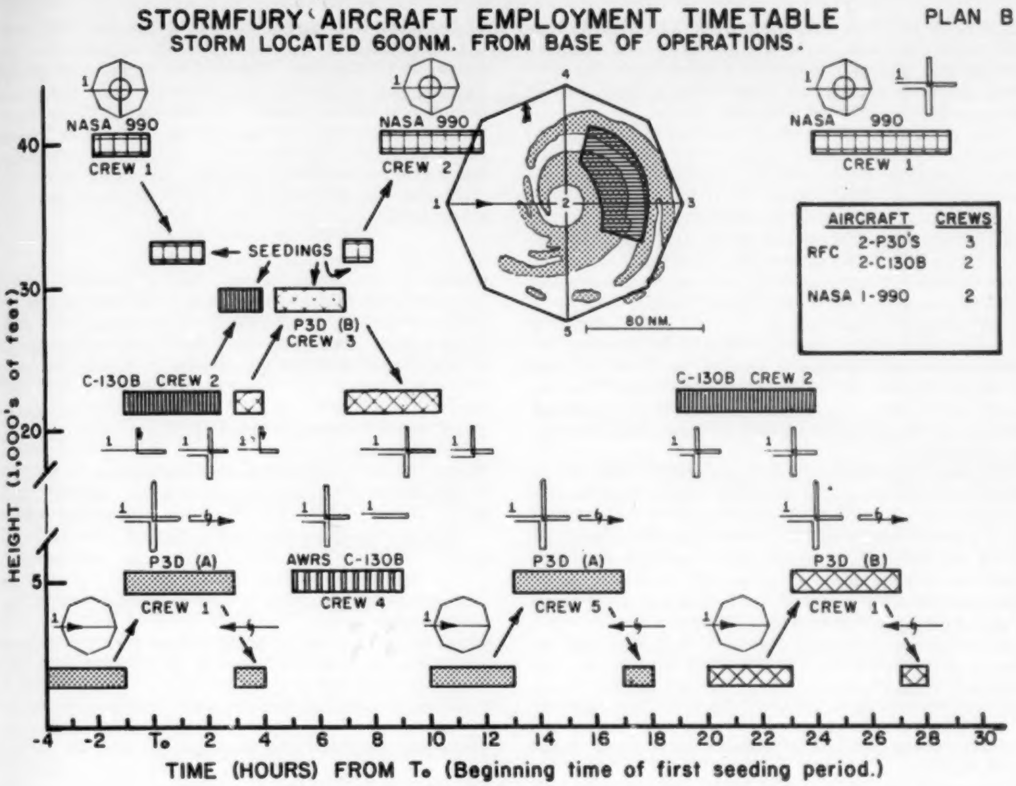

Figure 8.--STORMFURY aircraft employment timetable.

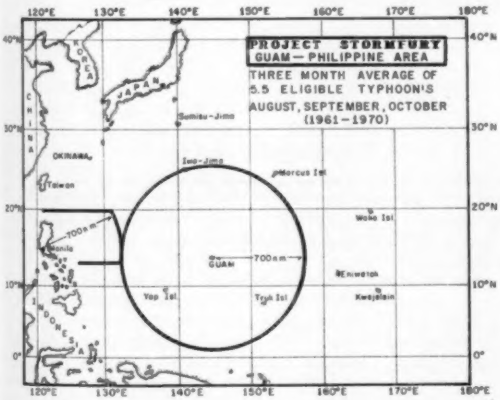

Figure 9.--Scheduled area (circle) of STORMFURY Pacific experiments.

the storm?

b. What is the probability of causing a change in the direction and speed of movement of the storm?
c. What changes in the total precipitation may occur?

All evidence presently available indicates that no significant changes should occur relative to these three facets of the storm. However, the guidelines covering the experiments include additional safeguards.

The most significant safeguard is that no seeding during these experiments will take place during the period of several hours before the storm makes landfall. The STORMFURY hypothesis states that the storm returns to its "natural" state within the period of 6 to 18 hr after the seeding stops. This is based upon theoretical computations and the results of previous experiments. The most complete case is hurricane Debbie, which underwent a very distinctive decrease in intensity on August 18 (fig. 6), and had returned to nearly its original state by early on the 20th (fig. 7).

The question of the alteration of rainfall is of concern to some nations. It is believed that the total rainfall associated with a hurricane is basically a function of the synoptic scale environment. Figure 4 illustrates the hypothesized change in the convective pattern. The primary change is an alteration of the inner core of the storm. Calculations, primarily based upon actual radar observations, indicate that changes of rainfall rates of as much as 30 percent in the inner core have little net effect on the total accumulated rainfall from the storm as it passes over a given area.

Finally, the fact that hurricane Debbie exhibited a typical radar structure at the beginning of both the August 18 and 20 experiments is further evidence that there were no significant long-term effects on the precipitation associated with this storm.

The movement of the storm is also believed to be a function of the synoptic scale environment, rather than the smaller scale motions hypothesized to be affected by the seeding. Several calculations and a numerical experiment are presently being made to demonstrate the possible effects on the hurricane movement of seeding in an asymmetric fashion. However, most storms are asymmetric, and their movement is as predictable as more symmetric cases. Furthermore, diffusion calculations indicate that materials dispersed in the fashion prescribed by the present hypothesis are rapidly spread around the storm. In all the cases illustrated in figure 5, including the two hurricane Debbie experiments, there were no apparent alterations in the track during, or immediately after, the seeding.

The final question is that of intensity. This is the area where the strongest evidence exists that no detrimental effects take place as a result of the seeding. In all seeded cases, no storm increased in strength during the monitoring period after seeding. Furthermore, the simulations by numerical models indicate that no increase will result if the seeding takes place as specified by the present hypothesis.

All evidence presently available indicates that the scheme described in the STORMFURY hypothesis may provide a means of decreasing the destructive force of hurricanes. Therefore, it seems that this technique should be explored as rapidly as possible. The plans for testing the STORMFURY hypothesis through 1978 are quite thorough and include many safeguards during this testing phase. By the end of these experiments, a practical technology may have been attained for beneficial modification of hurricanes (typhoons), and a new plateau will certainly have been reached in understanding the processes which maintain and drive a hurricane.

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WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US. THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

GREAT LAKES ICE SEASON, 1974-75

Year-Round Navigation Achieved

Daron Boyce
Great Lakes Ice Forecaster
National Weather Service, NOAA
Cleveland, Ohio

and

Bernard DeWitt
Bernard DeWitt & Associates
Ann Arbor, Mich.

Generally warmer-than-normal air temperatures and the press of the national economy pushed the winter fleets on the Great Lakes through the first year-round navigation season in history, during 1974 and 1975. Ice coverage was well below normal in most areas, but above-normal precipitation created more skim ice, which often filled shallow navigation channels such as the St. Marys River. On April 2, 1975, year-round navigation was achieved--a direct result of the efforts of hundreds of men and women and a governmental expenditure on extended-season navigation of over $7 million since 1970.

FALL SEASON

Prodded by the specter of low iron ore and coal stockpiles and bulging grain elevators around Lake Superior, ten Great Lakes shipping companies made plans to operate 50 vessels into January 1975. Warmer-than-normal surface-water temperatures and predictions of a warmer-than-normal fall also encouraged late sailors.

Deep storms during much of November and early December pounded the Lower Lakes with heavy snow and cold weather -- rapidly extracting heat from the waters. Lake Erie, Detroit, Cleveland, and nearby areas were buried in up to 2 ft of snow on December 1 and 2. It was Detroit's second-heaviest snowfall in a single storm in 100 yr.

On November 21, the 623-ft Canadian self-unloader ROY A. JODREY ran up on Pullman Shoal and, a few hours later, sank in 120 ft of water in the upper St. Lawrence River. Less than 2 wk later, on December 1, another Canadian freighter, the 200-ft JENNIFER, sank off Charlevoix, Mich. (Mariners Weather Log, March 1975). Four crewmembers were rescued from a lifeboat by a Coast Guard helicopter, and eleven other men were rescued by the British flag FORTUNA. The ship, which was under charter to Algoma Steel Corporation, was hauling 1,400 tons of steel, which may have shifted in gales and 10- to 14-ft waves. The ship sank about 7 min after the crew was saved.

Problems continued to hamper Great Lakes traffic into mid-December. On the 11th, two ships collided head-on in fog on the St. Clair River. Neither the American freighter H. LEE WHITE, in her first year of service, nor the Greek vessel GEORGIAS A. sustained major damage. Only a few days earlier, the PHILIP R. CLARKE and the MERLE MCCURDY had collided when passing on Lake St. Clair.

Plans were announced in November for the traditional closing of the St. Lawrence Seaway on December 17, and the Welland Canal on December 30. The latter date was later pushed back to January 17 to accommodate late-season movements of ore and coal from Canada to the United States. The last downbound vessel on the Seaway was the GEORGIAS A., complete with smashed bow. The FRANK SHERMAN was the last ship upbound. Some ships were laid up by the traditional December 15 deadline, but others fought on. Two million bushels of wheat had moved on the Lakes by midmonth, and another 40 million were expected to be awaiting shipment by the end of the season.

By mid-December, ice had begun forming at Duluth, the northern Superior bays, extreme southern Green Bay, the northern Bays de Noc, and Saginaw Bay. Shore ice formed from time to time during the month in the St. Marys River system and the Straits of Mackinac, but above-normal temperatures retarded further ice growth. By Christmas, strong winds blew all of the ice out of Saginaw Bay.

EXTENDED SEASON OPERATIONS

The prevalence of temperatures well above normal through early January resulted in greatly delayed significant ice growth. Preventative icebreaking operations were first started in Duluth-Superior by the USCGC WOODRUSH, and at Kipling in northern Green Bay by the cutter MESQUITE, between Christmas and New Year's. The first official icebreaking assist was made by the WOODRUSH, on January 4, when she escorted the G. M. HUMPHREY out of Duluth. Ice up to a foot thick was reported in western Lake Superior.

A devastating January blizzard that whipped through the Midwest, on January 10 through 12 (fig. 10), set

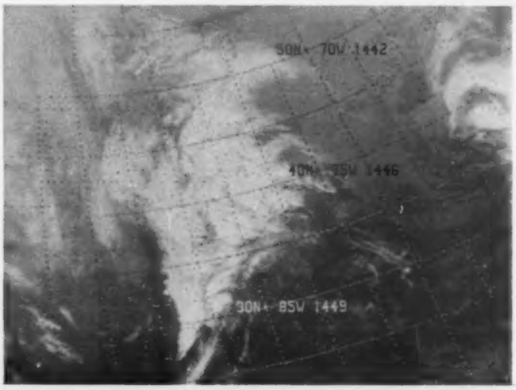

Figure 10.--This infrared satellite picture shows the storm, on the 10th, prior to devastating the area with deep snow and drifts, and a record low sea-level pressure.

Figure 11.--The FRONTENAC plows through the ice near Nine Mile Point, on the St. Marys River. Photo courtesy of Dwight Boyer, Cleveland Plain Dealer.

the stage for many more assists to come. The monster storm, described by some observers as "the worst blizzard of the century," moved directly across Duluth and western Lake Superior, during the early hours of January 11. Snow up to 2 ft was dumped on the city, and winds in the wake of the center's passing piled it into 20-ft-high drifts. A low pressure of 966.8 mb was recorded at Duluth--the lowest in the State's recorded history. Unofficial reports indicated winds of 93 kn on western Lake Superior during the storm. The tug JAMES HANNAH, pushing a 290-ft barge, battled 65-kn winds, and ice buildup on her hull caused her to list 5° before arrival in Bay City, Mich., from Chicago. Coast Guardsmen who remained on duty throughout the storm on Lansing Shoal Light estimated the entire light structure was covered with ice 2 ft thick from the storm spray.

The much colder temperatures brought by the blizzard lowered the St. Marys River water temperature to near freezing, and rapid ice formation began. Just prior to the storm, the 34°F water temperature at Sault Ste. Marie was the warmest for the date since records started in 1906. Thicknesses increased from 6 in to 12 to 14 in. Six- to 12-in ice also formed on Saginaw Bay, Lake St. Clair, Green Bay, and western Lake Erie. The first icebreaking assist in Green Bay was chalked up by the USCGC MESQUITE, while escorting the tanker MERCURY out of Escanaba on January 14.

The colder weather persisted, and major Coast Guard icebreakers were deployed. On January 20, 1975, the icebreaker MACKINAW moved to her winter station at Coast Guard Base Sault Ste. Marie for work on the St. Marys River, and 2 days later the WESTWIND headed from Milwaukee to her winter home in St. Ignace, Mich. By the end of January, the Straits of Mackinac had become mostly covered with 4- to 12-in ice, and difficult navigation conditions were common. Ice growth up to 16 in also continued in Whitefish Bay, on eastern Lake Superior. Lack of cold weather around the Lower Lakes resulted in much open water on Lake Erie and Lake St. Clair.

The Coast Guard closed the West Neebish Channel to navigation on January 22, and the Army Corps of Engineers cut back operations at their locks at Sault

Figure 12.--The ROGER BLOUGH moves down the St. Marys River at Little Rapids Cut to establish a new late-season navigation record for the Great Lakes, on February 9, 1975.

Figure 13.--At Little Rapids Cut, just down the river from Sault Ste. Marie, the SUGAR ISLANDER awaits the BLOUGH's passage to make a trip to her dock on the island. The USCGC ARUNDEL stands ready to assist in the transit if needed, and, in the background, a commercial tug prepares to clear the ferry dock area of ice.

Ste. Marie to two shifts per day on January 26. Trade into northern Green Bay ended on January 29, 1975, with the loading of the G. M. HUMPHREY at the Escanaba ore docks. The LEON FALK closed out the Duluth ore trade on January 27.

Ice continued to increase in the north during early February, with Whitefish Bay becoming nearly ice-covered. Whitefish Bay, along with the St. Marys River (fig. 11) and the Straits of Mackinac, became increasingly difficult for navigation, with icebreaker assistance required. As the ice increased, the number of vessels plying the icy water dwindled to less than a dozen. Nearly constant icebreaking operations were needed in the St. Marys River to keep traffic flowing. Ice finally managed to lodge in Little Rapids Cut, on February 8, and remained until midmonth. Brash ice in the vicinity of the cut was ridged and rafted 6 ft deep at times. A number of Federal agencies had placed special emphasis on the cut in order to keep the ferry SUGAR ISLANDER, which serves the residents of Sugar Island, operating through the winter. Residents of the island, as well as mainland citizens and the Coast Guard, were on hand to watch the U.S. Steel boat ROGER BLOUGH set a new extended-season record on February 9, 1975 (figs. 12 and 13). By this time, solid ice in Whitefish Bay was up to 4 ft thick. The record continued to be broken with each ship passage thereafter, as the fleets of winter pushed their way to a year-round season.

By February 10, Lake St. Clair (fig. 14) and western Lake Erie were mostly covered again with 2- to 8-in ice, and some new ice was observed on southern Lake Huron. By midmonth, the drift ice from southern Huron began moving into the downwind rivers as far as Detroit. The tug TABOGA was assisted by the buoy-tender MARIPOSA, on February 16, in the St. Clair River.

Above-normal temperatures during the latter part

Figure 14.--Snow and ice piled up in Lake St. Clair. Photo courtesy of Lake Survey Center.

of February diminished ice cover somewhat on Lake Superior and other shoreline areas. However, brash ice near Little Rapids Cut on the St. Marys was ridged as high as 133 in (fig. 15). A large part of the ice cover of Saginaw Bay, Lake Huron, Lake St. Clair, and Lake Erie was lost. Also, a large open area in northern Green Bay opened up by month's end. Winds jammed much ice into 2-ft ridges in the Buffalo area.

In order to maintain a year-round schedule at the Soo, the Corps of Engineers closed the large Poe Lock for repairs, on March 1, 1975, and opened the MacArthur. The last transit of the large lock was made by the 858-ft ROGER BLOUGH. The USCGC MACKINAW was the first into the MacArthur, marking the earliest opening of the lock in the Soo's history. The vessel C. J. CALLOWAY followed shortly thereafter and became the first boat over 700 ft ever to move through the smaller lock.

The late fall and winter months averaged above nor-

Figure 15.--A satellite view of the Great Lakes ice cover. The photograph was made by a NOAA satellite in February--the period of maximum Great Lakes ice cover.

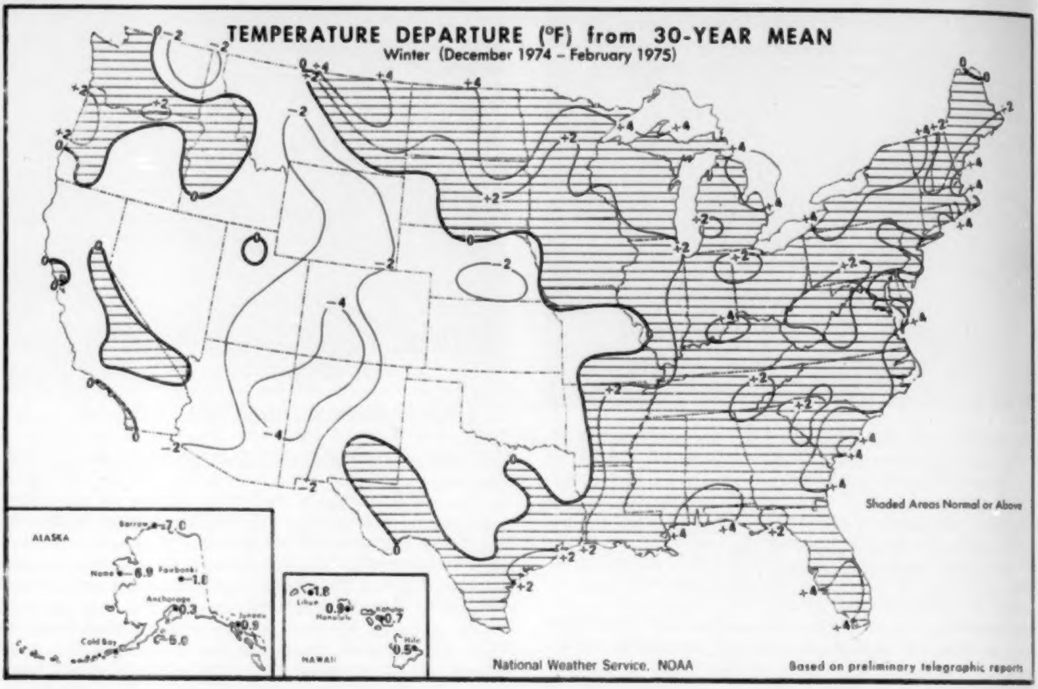

Figure 16. -- Temperatures during December through February averaged above normal over all of the Great Lakes.

mal in temperature (fig. 16), but a dramatic change took place in March. A cold start to the month was marked by some refreezing in bay and shoreline areas of Lakes Superior, Huron, Michigan, and Erie. Warmer temperatures by midmonth resulted in reduction of ice cover in most areas. By the 24th, considerable open water had appeared in northern Green Bay, and ice cover in the Straits of Mackinac and Saginaw Bay had diminished and become less difficult. The warmth was brought northward by a large storm on March 21 and 22. The southerly gales pushed the C. J. CALLOWAY aground on the southeast corner of Lansing Shoal on March 21. A few hours later, the Coast Guard closed the Straits of Mackinac because of the high winds and shifting ice floes. Damage to the CALLOWAY was estimated at $100,000. On March 22, the icebreaker WESTWIND was partially disabled by a steering failure.

Meanwhile, in the Lower Lakes, the USCGC OJIBWA was working hard on an ice jam in eastern Lake Erie, between Fort Erie, Ontario, and Buffalo, N.Y. She completed a track into the harbor, but recommended that only high-powered steamers attempt to follow through the pressured pack. Drift ice flowing down the St. Clair River also continued to cause problems (fig. 17). Occasional jams in the river brought flooding around Marine City, Mich., on the 17th, and a jam near Harsen's Island, on the 22d, stopped the ferry. School children and teachers were transported to the mainland by the USCG Cutters KAW and MARIPOSA. Ice cover diminished late in the month, and Lakes St. Clair and Erie were nearly ice-free by March 24.

With the marked extension of Great Lakes navigation to year-round operations during 1974-75, determining the length and the end of the shipping season became a new problem--and basically a question of judgment. For statistical purposes, the Great Lakes Commission set March 20 as the threshold date. Using that date, the Lakes-Seaway iron ore tonnage for the 1974-75 season totaled slightly over 90 million gross tons. This is about 4.5 percent below the 1973 season total of 94.3 million gross tons, but is the only other 90-million-ton season for ore since 1953. About 4.1 million tons were carried between January 1 and March 20, 1975.

SPRING OPERATIONS

On March 25, 1975, both the St. Lawrence Seaway and the Welland Canal opened for navigation--the earliest ever. The Canadian lakers RICHELIEU and LAKE WINNIPEG were the first boats in the Seaway, up and downbound, respectively. Heavy fog slowed traffic for several days on the international waterway. The Welland, closed only 66 days, welcomed the Canadian H. M. GRIFFITH and ISLAND TRANSPORT, as first boats through the 26-mi waterway.

Encouraged by the milder weather and the economy, many of the smaller vessels started operations in mid- or late March. The fickle early spring weather played its tricks, however, and problems were numerous. A storm on March 24 and 25 caused the longest delay

Figure 17.--The USCGC ACACIA teamed up with an HH52A from Air Station Detroit to free the S. T. CRAPO from an ice jam in the lower St. Clair River. Photo courtesy of Paul Michaels, Marine Photographs, Flint, Mich.

in shipping of the winter, when the Coast Guard closed the entire stretch from Whitefish Bay through the Straits of Mackinac because of high winds, low visibility, and shifting ice floes. Other storms churned through parts of the Lakes Region, on March 28 and April 2. Many small boats were trapped in Upper Lakes ice--some for 2 or 3 days.

Unseasonably cold temperatures in April greatly retarded the decay of the remaining ice cover in the north. Early in April, some new ice formed in shallow areas. Very slow decay continued through midmonth. The tough ice took its toll, with ship damage being reported to the Coast Guard by the SATURN, NICOLET, and AMOCO WISCONSIN. The by-then-tired icebreaking fleet also sustained damage amounting to over $155,000 in March and April.

Shortly after midmonth, Whitefish Bay became mostly ice-free in the western half. The St. Marys River ice cover was breaking up, and Duluth-Superior became mostly ice-free. Green Bay ice cover began to diminish rapidly, and the Straits of Mackinac became ice-free. Rapid deterioration continued through the end of April, with Whitefish Bay about 30-percent covered by the 30th, and the St. Marys River, Green Bay, and the lower Bays de Noc mostly ice-free. Three other commercial boats reported damage in late April--CLIFFS VICTORY in Whitefish Bay, JOSEPH YOUNG at Sturgeon Point, Minn., and the SUGAR ISLANDER on her ferry run in the St. Marys River. The West Neebish Channel was opened on April 22, the latest since 1972. Icebreaking activities in Green Bay and the Bays de Noc ended formally on April 25, and in the "Taconite" responsibility area of Lake Superior, the St. Marys River, and the Straits of Mackinac, on April 30, 1975.

SUMMARY

The 1974-75 Great Lakes Ice Season, like the previous three seasons, was warmer than normal. Considerably less navigationally significant ice formed than normal. The lack of ice and national economic pressures pushed shipping traffic through Great Lakes waters with only minor stoppages and resulted in the first year-round navigation season.

One indication of the mild winter can be found in the departures from normal of air temperature (table 1). The tabulated values are from selected National Weather Service offices around the Lakes. From November through February, temperatures were above average and, in some cases, well above, while March and April were well below normal. Therefore, the seasonal averages by lake were only slightly above average.

Another indicator of the severity of the winter is the maximum accumulated freezing degree days (table 2). As seen in this table, the totals were generally

Table 1.--Departures from normal of Great Lakes air temperature (°F) for 1974-75 season

Months	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
November	+1.0	+1.0	+1.0	+0.8	-1.0
December	+5.0	+3.6	+2.4	+2.0	+3.1
January	+1.7	+4.5	+4.1	+3.2	+5.4
February	+2.0	+0.9	+2.2	+2.8	+3.6
March	-3.1	-3.0	-2.0	-1.8	-1.4
April	-6.4	-6.0	-6.1	-6.7	-6.9
November - April	±0.0	+0.2	+0.3	+0.4	+0.5

Table 2.--Maximum accumulated freezing degree days+ (FDD) in °F

Station	Maximum accumulated FDD 1974-75	Date	Normal maximum accumulated FDD	Date	1974-75 season versus normal
Duluth	2301	April 13	2281	April 3	+ 20 (Colder)
Marquette	886	April 12	1361	March 30	-475 (Warmer)
Sault Ste. Marie	1633	April 13	1702	April 3	- 69 (Warmer)
Green Bay	1253	April 5	1416	March 26	-163 (Warmer)
Milwaukee	683	March 16	880	March 15	-197 (Warmer)
Muskegon	386	March 15	593	March 16	-207 (Warmer)
Alpena	964	April 12	1164	March 28	-200 (Warmer)
Detroit	385	March 15	*		-115 (Warmer)*
Toledo	317	March 16	500	March 2	-183 (Warmer)
Cleveland	104	February 15	343	February 28	-239 (Warmer)
Buffalo	245	March 15	489	March 18	-244 (Warmer)
Rochester	252	March 11	586	March 18	-334 (Warmer)

+A freezing degree day figure is obtained for each site by subtracting the mean temperature for the day from 32°F. Cumulative totals are compiled with negative daily figures (melting degree days) included.
*Information not available--use Toledo normal.

Table 3.--Summary of icebreaking assistance

	Operation hours in direct assistance	Mission miles	Total tonnage (GRT) of vessels assisted	Total cargo tonnage carried by vessels assisted*	Total value of cargo carried by vessels assisted*
FY 1971	4,080	14,101	3,453,708	2,520,152	$53,965,269
FY 1972	2,446.5	11,765.5	3,617,431	2,276,384	$61,862,404
FY 1973	1,341.6	9,494.2	2,076,701	1,470,995	$27,977,811
FY 1974	3,872.4	12,807.1	3,115,605	1,681,127	$45,640,302
FY 1975	2,575.2	11,275.4	5,788,909	3,662,653	$10,933,614**

*Types of cargo carried: cement, coal, grain, iron ore, limestone, petroleum products, pellets, soy beans, steel, taconite, wood pulp, and general.
**This figure is not representative of the true value of cargo carried due to the lack of reported values.

below normal--indicative of the milder-than-normal winter season. For northern localities, the date of maximum accumulation occurred well into April, in agreement with the very cold April temperatures which were observed, and consistent with the delayed decay of the ice cover. On the other hand, the below-normal values for the southern sections indicate the lack of prolonged cold periods necessary for long-lasting and thick ice cover.

More vessels participated in the winter navigation program this season than ever before on the Great Lakes. A total of 152 boats sailed during some portion of the season, from December 15, 1974, through April 1, 1975. This compares with 122 during the 1973-74 season, and 91 during 1972-73. Because of the mild winter, however, even with more boats transiting the Lakes, icebreaking operations hours and mission miles in direct assistance were down. Total tonnage of the vessels assisted was considerably above previous years, mainly due to the increased use of larger ships (table 3).

ACKNOWLEDGEMENT

Icebreaking data and casualty information were supplied by LT Tom Brennan, Chief, Icebreaking Section, Ninth Coast Guard District, Cleveland, Ohio.

gulfstream

Diane Moravek
National Weather Service, NOAA
Silver Spring, Md.

The National Weather Service (NWS) began publishing gulfstream as of January 1975. This periodical was produced by the U.S. Naval Oceanographic Office, from January 1966 through December 1974, under the title, The Gulf Stream Monthly Summary.

The new gulfstream continues to include mean sea-surface temperatures (SST), long- and short-term SST anomalies, and selected bathythermographs (BT) for the area extending from 25° to 45°N, and 55° to 85°W. Special articles concerning interesting or unusual characteristics of the Gulf Stream are also being continued in the publication.

The lead chart in the publication each month (fig. 18) depicts the position of the Gulf Stream North Wall for both the beginning and end of the month, with the historical mean position of the maximum current for each month added for reference purposes. These positions are determined with the aid of satellite imagery, bathythermographs, airborne radiation thermometers, and ship-injection temperatures. If the southern edge of the stream or other features, such as the slope front, can be determined, which happens often under cloud-free conditions, they are also included on the chart. Cyclonic and anticyclonic eddies and the dates they were observed are indicated as well. The life cycles of these eddies are usually long; thus, their movements may be followed from month to month.

The second chart (fig. 19) shows a collection of BT's for the area. As many as 20 BT's may be included, representing different water-mass types. If possible, BT's taken in eddies or across fronts are included, as these are of particular interest. The BT's are middle-of-the-month data in order to portray the most representative picture for that particular month.

The SST charts give several pieces of useful information. The mean SST for each 1° quadrangle is placed on the chart (fig. 20), if there were at least four observations within that quadrangle for the month. The frequency of temperature observations is also included in each quadrangle. From these data, an analysis is prepared on a separate chart (fig. 21) with isotherms at 2°C intervals and the mean temperature by 5° quadrangles. Temperature and depth units on all charts are in Celsius and meters, respectively.

An analysis of the anomaly between the 100-yr mean SST and the monthly mean SST, by 1° quadrangles, is presented (fig. 22). Appearing on the same page is the monthly SST change between the previous and present months--again calculated by 1° quadrangles (fig. 23). The numerals are color-keyed to differentiate those temperatures lower, higher, and with no change, as applies to each chart. As with the SST charts, values are only calculated if at least four observations are available.

The final item to appear in each issue is the special article, consisting of a short text and graphics. The article may be about research being conducted, or it may be on some interesting or unusual feature associated with the area. These articles are made as timely as possible, in keeping with the objective of publishing gulfstream within 30 days after the end of each month. Contributions for the monthly article are welcomed, and appropriate author credit will be given. Please send materials to:

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Editor, gulfstream
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8060 13th St.
Silver Spring, Md. 20910
Phone: 301-427-7278

Scientific and commercial interest in the region is substantial and is reflected in the wide variety of subscribers. Among these are: oceanographers from many universities, the National Science Foundation, the U.S. Coast Guard, the U.S. Navy, NASA, most of NOAA's components, and, from the private sector, fisheries, airlines, and oil companies. Various parties in 19 foreign countries receive gulfstream as well. Subscribers have stated that the publication is used in planning and conducting research, as ocean climatological records, for teaching, in search and rescue operations, for navigational purposes, and in forecasting weather.

The price of the publication is \$0.45 per copy, or \$4.95 for an annual subscription. Domestic airmail and foreign subscriptions are slightly more. Orders should be placed with the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

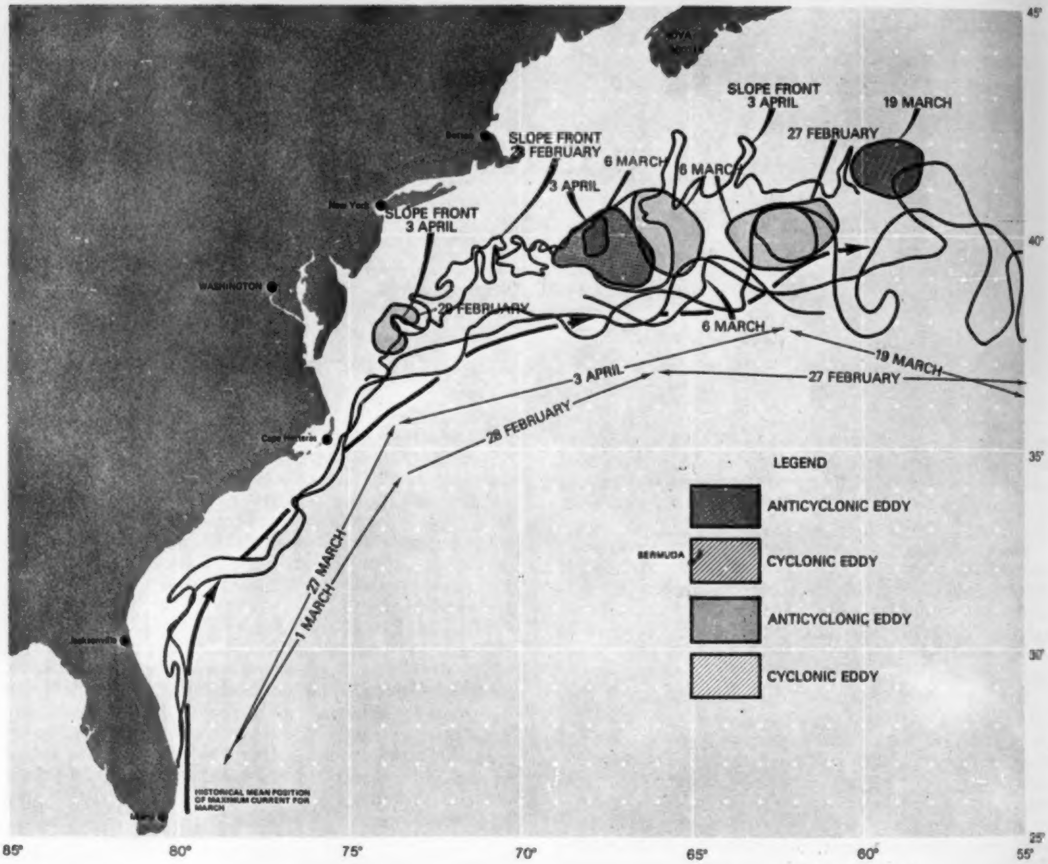


Figure 18.--Gulf Stream Position. (The gulfstream publication depicts charts in various colors.)

The northern edge is shown in blue for the beginning of the month and in orange for the end of the month. The edge was located by the strong sea surface temperature gradient north of the uniform warm core or by the 15° C isotherm at 200 meters. Solid and broken lines indicate recorded and estimated positions respectively. The position of the maximum current was calculated from H.O. Publication 571 (out of print).

The Gulf Stream region between Cape Hatteras and 50°W can be categorized as highly active during March 1975. Meanders and eddies were forming while older eddies were being recaptured by the stream. The anticyclonic eddy centered at 39° 30'N, 67° 30'W on 3 April has been tracked since 31 December 1974 when it was located at 41° 20'N, 62°W. After three months of surface cooling, it still remains clearly visible through satellite imagery. The eddy centered at 40N 62° 30'W on 6 March coalesced with the Gulf Stream as anticipated, ending a relatively short life cycle. That eddy appears as part of the large meander at 62°W on 19 March. The anticyclonic eddy at 41° 30'N, 59°W broke away from the stream shortly before 19 March. The slope front was clearly visible on 3 April from Cape Hatteras to 60°W and a band of shelf water could be seen almost encircling the eddy at 67°30'W on that date.

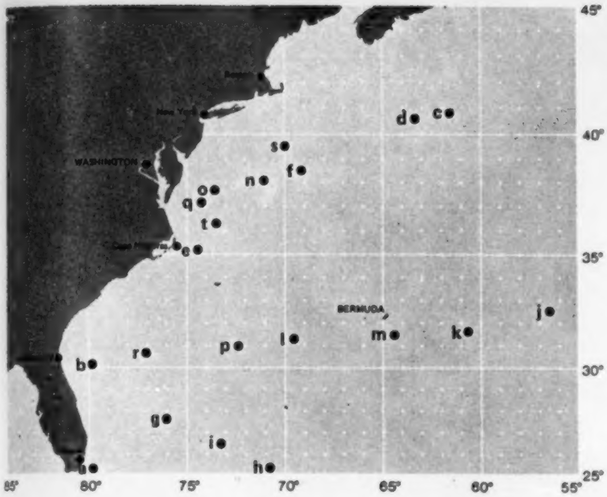


Figure 19.--Selected Bathythermograms.

MARCH 1975

This chart shows typical near-surface thermal structure in Gulf Stream and surrounding waters. Number in lower right corner of each trace indicates date.

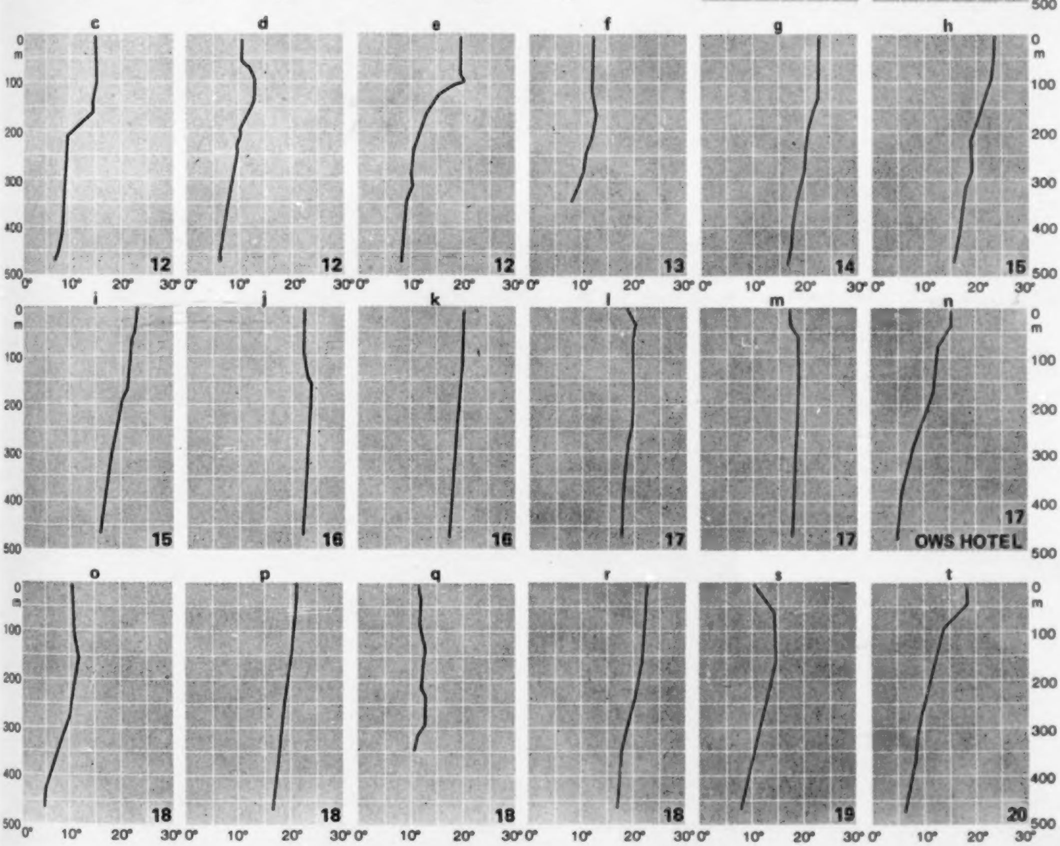


Figure 20. --Mean Sea-Surface Temperature (°C).

March 1975

Isotherms are based on mean temperatures computed for each one-degree quadrangle. Blue numerals indicate mean temperature by 5-degree quadrangles.

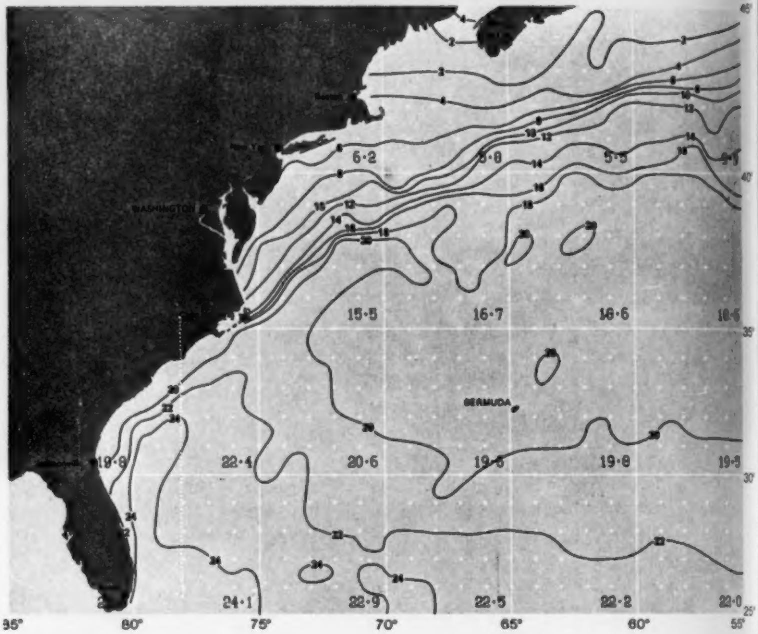
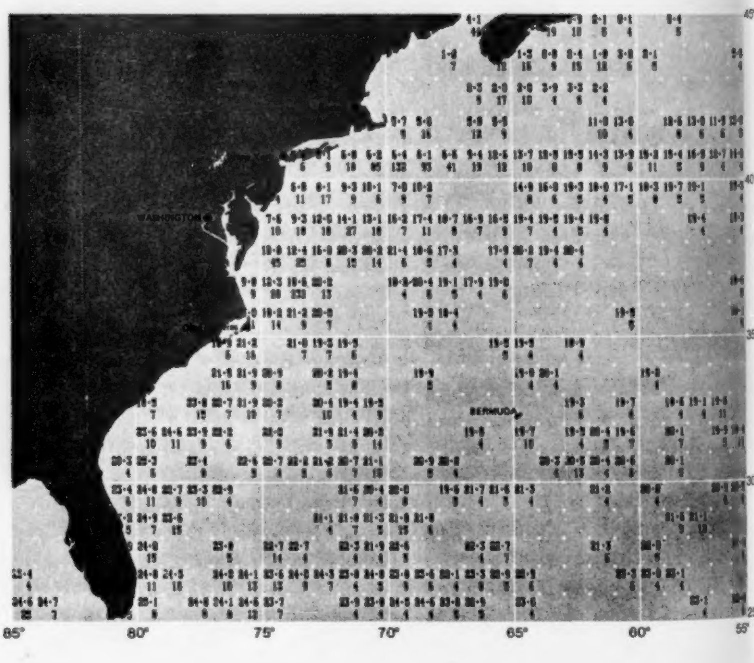


Figure 21.--Surface Temperature Observations (°C).

March 1975

This chart is the data base for the above chart and shows mean temperature and frequency of observations for each one-degree quadrangle. Values are shown if at least four observations were available.



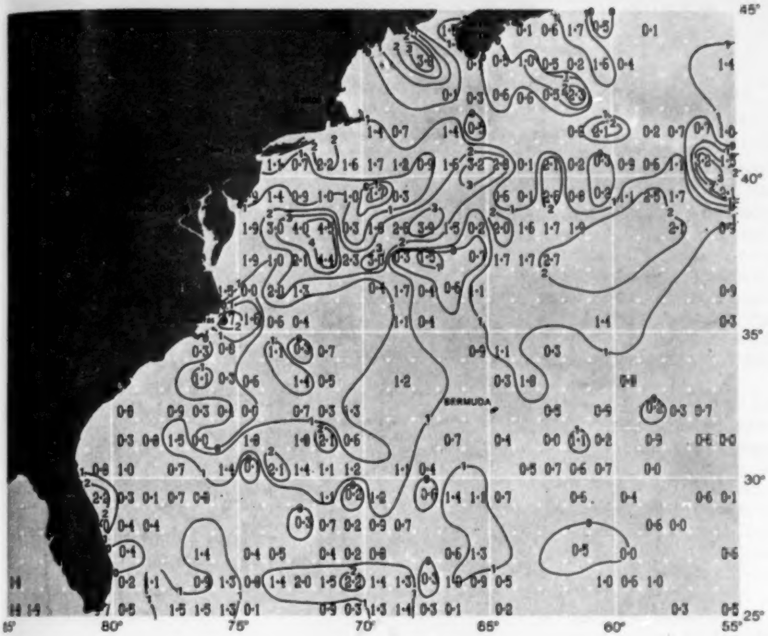


Figure 22. --Sea-Surface Temperature Anomaly (°C).

March 1975

The anomaly is the difference between the monthly mean sea surface temperature and the historical (approximately 100 years) mean monthly value. Orange numerals indicate monthly means greater than the historical mean; blue numerals indicate monthly means smaller than the historical mean. Values were calculated if at least four observations were available.

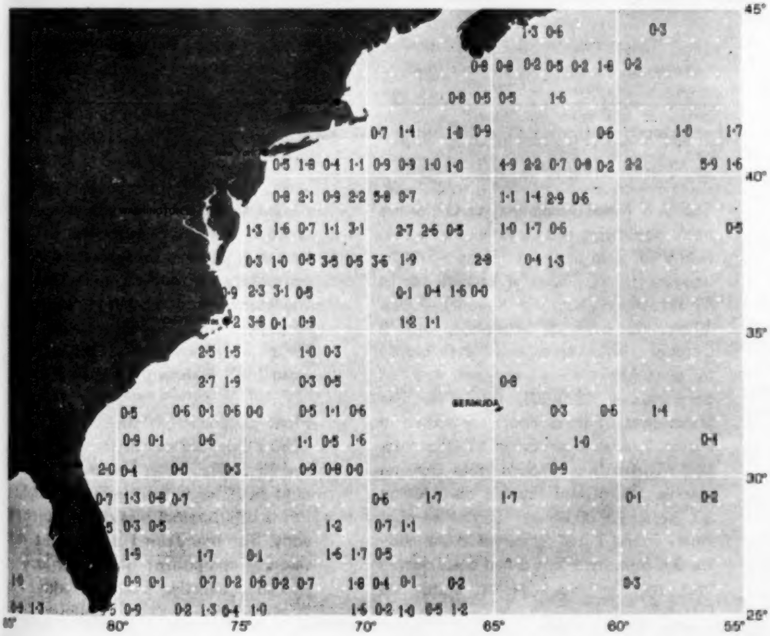


Figure 23.--Monthly Sea-Surface Temperature Change (°C).

March 1975

Orange numerals indicate present monthly values higher than the previous month; blue numerals indicate values lower than the previous month. Values were calculated if at least four observations were available for each month.

Hints to the Observer

DEVIATIONS IN BAROMETRIC PRESSURE

When gusty winds and turbulence around the superstructure of a ship are strong, many observers have noted significant pressure fluctuations in the barometer. These pressure fluctuations are shown by vertical oscillations of the mercury column in a mercurial barometer, or by variations of the needle in an aneroid barometer. Such behavior in pressure-measuring instruments is called "pumping" and can be caused by:

(1) The pitch and roll of the ship.
(2) The swing of a mercurial barometer about the point of support.
(3) The effect of wind gusts on the air pressure of the room in which the barometer is hung.
(4) The variations in atmospheric pressure due to the change in height of the ship as she rides from the trough to the crest of a wave.

Civil engineers have studied the deviation of the barometric pressure with wind. Based on their experiments, table 4 shows how great these deviations can be in a building, a chartroom, or the bridge of a ship.

A device which minimizes the effect of pumping on the barometer has been tested and is called a static pressure system. Most ships which have air conditioning utilize this system to damp out pressure deviations, since the pressure inside the ship would be greater than the static pressure outside. For those ships without air conditioning, it is advisable to keep both the weather and the lee doors closed during the observation of pressure. Several readings of the barometer should be averaged so that the effect of any of these pressure deviations is minimized.

Table 4. --Average pressure deviations*

Windspeed (kn)	Pressure deviation (mb)
25	0.3
50	1.2
75	2.7
100	4.9
125	7.6
150	10.9

*This table is based on the equation:

$$q = \frac{CbdV^2}{2}$$

where q is the pressure deviation, d is the density of air, and V is the windspeed. C and b are constants based on the structure characteristics and the units of pressure, windspeed, etc., being used.

Tips to the Radio Officer

Warren D. Hight
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Silver Spring, Md.

CORRECTIONS TO PUBLICATION, RADIO STATIONS ACCEPTING SHIPS' WEATHER OBSERVATIONS

Page 18--Simonstown, South Africa (ZSJ): Delete; station accepts AMVER messages only.

Page 19--Dzaoudzi, Comoro Is. (FJN): Delete entry.

CORRECTIONS TO PUBLICATION, WORLDWIDE MARINE WEATHER BROADCASTS

Page 6--Halifax, Nova Scotia (CFH): In list of frequencies, replace 115.3 with 438[2]. Add footnote: [2] Off the air 1200-1600 second Thursday each month.

Page 9--Grindstone, Quebec (VCN): Amend contents of A1 broadcast (440 kHz) to read "Synopsis and forecasts for areas a, e, k, l, m, r, s, and x."

Pages 9 & 10--Boston, Mass. (NMF): Effective October 31, 1975, the A3J broadcasts on 8764 kHz at 0130, 0730, 1330, and 1930 GMT will be discontinued. Delete related details.

Page 16--New broadcast. Insert the following:

Station: WASHINGTON, D.C. (NMH)
Area affected:[1]
(a) North Atlantic north of 03°N, and west of 35°W, including Gulf of Mexico and Caribbean Sea.
(b) Offshore waters: north of 41°N, and west of 60°W (New England Waters).
(c) Offshore waters: 32°N-41°N, and west of 65°W (West Central North Atlantic Waters).

(d) Offshore waters: Southwest North Atlantic.

Call sign	Time of broadcast	Frequencies (kHz) and mode	Content
NMH	0400	4393.4 (A3J) 6521.8 (A3J) 8760.8 (A3J)	Synopsis and forecast, areas b and c.
	0530	do.	Synopsis and forecast, area a.
	1000	do.	Synopsis and forecast, areas b, c, and d.
	1130, 2330	6521.8 (A3J) 8760.8 (A3J) 13144 (A3J)	Synopsis and forecast, area a.
	1600, 2200	do.	Synopsis and forecast, areas b, c, and d.
	1730	8760.8 (A3J) 13144 (A3J) 17290 (A3J)	Synopsis and forecast, area a.

[1]See figure 3, page 11.

Page 18--Charleston, S.C. (NMB, WJO): Amend "Area affected" to read:
(a) Coastal waters: Virginia Beach, Va., to Savannah, Ga.
(b) Coastal waters: Cape Fear, N.C., to Ponce de Leon Inlet, Fla.
Revise NMB details as follows:
NMB/0420,1620; on receipt/2670/A3H/500w
NMB/1100,1700,2200/157.1 MHz, Ch. 22 (F3)
0420,1620/Forecast/Forecast and warnings, area b.
On receipt / Warnings / Small craft / gale / storm/hurricane warnings.
Revise WJO details as follows:
0015, 1215 / Forecast/ Forecast and warnings, area a.

Page 18--Jacksonville, Fla. (NMV-3, WNJ): Amend "Area affected" to read "Coastal waters: Savannah, Ga., to Jupiter Inlet, Fla." Delete all details pertaining to NMV-3.

Page 18--New broadcast. Insert the following:

Station: MAYPORT, FLA. (NMA-10)
Area affected:[1] Coastal waters: Savannah, Ga., to Jupiter Inlet, Fla.

Call sign	Time of broadcast	Frequencies (kHz) and mode	Content
NMA-10	0620, 1320, 1520, 1820	2670 (A3H)	Forecasts and warnings
	1110, 1710, 2210	157.1 (MHz) Ch. 22 (F3)	Forecasts and warnings
	On receipt[2]	2670 (A3H) 157.1 (MHz) Ch. 22 (F3)	Warnings

[1]See figure 3, page 11.
[2]Preceded by announcement on 2182 kHz and 156.8 MHz.

Page 20--Miami, Fla. (NMA, WDR): Delete all details relative to NCF (2670 kHz) broadcast.

Page 20--Miami, Fla. (NCF): Insert following details:

Station: MIAMI BEACH, FLA. (NCF)
Area affected:[1]
(a) Jupiter Inlet, Fla., to Key West, including Florida Straits.
(b) Offshore waters: Southwest North Atlantic.

Call sign	Time of broadcast	Frequencies (kHz) and mode	Content
NCF	0000, 0350, 0900, 1100, 1300, 1550, 1800	2670 (A3H)	Forecasts and warnings, areas a and b.
	1130, 1730, 2230	157.1 (MHz) Ch. 22 (F3)	Forecasts and warnings, area a.
	On receipt[2]	2670 (A3H) 157.1 (MHz) Ch. 22 (F3)	Warnings

[1]See figure 3, page 11.
[2]Preceded by announcement on 2182 kHz and 156.8 MHz.

Page 40--Rio de Janeiro, Brazil (PPR): Opposite "0100, 0600, 1000, 1200, 1500, 2100," change "500 kHz" to "435 kHz"; change class of emission to "A1," and power to "5 kw." Opposite "0400, 2020" broadcast times, amend list of frequencies to read "435, 4244, 8634, 13105.5, 17077, 22603 kHz." The power of these transmissions has been changed to 1 kw. Below, opposite "Warnings," insert broadcast time "0400"; the entry will then show that the 0400 broadcast includes warnings, analysis, and forecast for area c.

Page 41--Notice to Mariners 36-74 contained an insert for Rio de Janeiro, Brazil (PWZ). Delete those details and insert the following:

Station: RIO DE JANEIRO (PWZ)
Area affected:
(a) Atlantic Coast from Uruguay to French Guiana.
(b) South Atlantic waters: 07°N-36°S, west of 20°W.

Call sign	Time of broadcast	Frequencies (kHz)	Class of emission	Power (kw)
PWZ	0030, 0630	4289	A1	10
	1730	6435	A1	10
		8550	A1	10
		12754.5	A1	10
		17160	A1	10
		22530	A1	10

Time of broadcast	Type of message	Contents
0030, 0630	Warnings	Warnings for area affected.
	Forecast	Forecast for area affected. In Portuguese, repeated in English.
1730	Warnings	Warnings for area affected.
	Forecast	Forecast for area affected. In Portuguese, repeated in English.
	IAC FLEET	Analysis for area affected. Code FM46D.
	SYNOP	Weather reports from: Trinidade Island, Fernando de Noronha Island, and Abrolhos Island.
	SHRED	Ship reports, Code FM 23.E.

ACKNOWLEDGEMENT OF CORRESPONDENCE

Many thanks to E. Stilling, RO, EVELYN MAERSK, and R. D. Twist, RO, CECILIE MAERSK, for information recently received from them.

Hurricane Alley

Dick DeAngelis
Environmental Data Service, NOAA
Washington, D. C.

During May and June, North Indian Ocean activity usually reaches a peak second only to that of the October - November period. An average of one to two tropical cyclones usually occur during this period. In the Southern Hemisphere, May and June offer little tropical activity, although a storm is more likely around Australia than in the southwest Indian Ocean.

NORTH INDIAN OCEAN

A tropical cyclone developed in both the Bay of Bengal and in the Arabian Sea, early in May. The Arabian Sea storm had her beginnings in late April, but it wasn't until early May that she became organized. She developed just south of the Laccadive Islands, meandered northward, and quickly reached hurricane strength. She was a hurricane from the 3d through the 5th (fig. 24). Maximum winds were estimated at about 75 kn near her center during that period. She lasted another week as a tropical storm.

Meanwhile, the Andaman Sea was giving birth to a

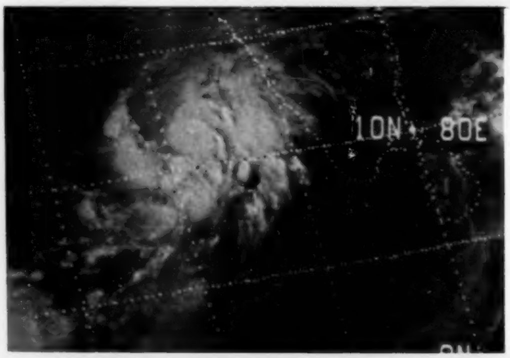

Figure 24.--Off the southwest coast of India, a tropical cyclone begins to sport hurricane winds on May 3.

Figure 25.--Off the Burmese coast, this tropical cyclone exhibits a distinct eye around her 65-kn winds.

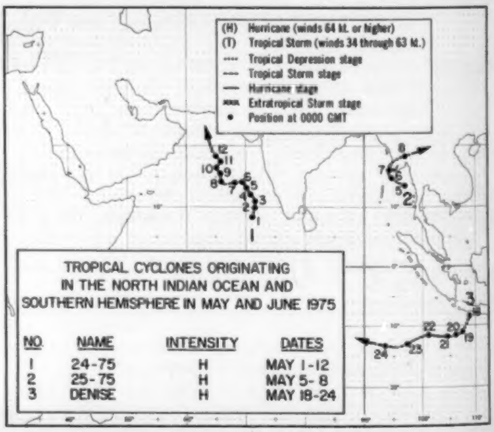

Figure 26.--Tracks of Indian Ocean tropical cyclones, May and June 1975.

short-lived hurricane. The storm was first detected on the 5th. She headed northwestward toward the Burmese coast, attaining hurricane intensity the following day, when winds near her center reached 65 kn (fig. 25). However, she quickly lost that intensity and recurved inland, on the 7th, along the east Burma coast. Tracks are shown on figure 26.

SOUTH INDIAN OCEAN

Although she became a hurricane, Denise slipped quietly, almost unnoticed, through the northeastern South Indian Ocean in late May. Spawned off the coast of Java on the 18th, she began her journey on a southwesterly heading. By the 20th, she turned westward and, the following day, became a hurricane. Winds blew at 65 kn near her center, while gales extended out about 100 mi. This small, severe storm crossed several major shipping lanes, but there were no reports of winds greater than 20 kn. On the 23d, Denise began to weaken.

On the Editor's Desk

VETERAN PORT METEOROLOGICAL OFFICER RETIRES

Paul A. Arnerich, Port Meteorological Officer and Marine Supervisor at the National Weather Service Marine Observations Service Office at San Francisco, retired on June 30, 1975, after more than 37 yr of federal service (fig. 27). As Marine Supervisor, he was responsible for the U.S. merchant vessel weather-reporting program in the Pacific area and supervised the activities of Port Meteorological Officers at the major U.S. Pacific Coast ports, including the Panama Canal Zone, Alaska, and Hawaii.

Figure 27.--Paul A. Arnerich.

Mr. Arnerich was the dean of U.S. Port Meteorological Officers, having reported on board at San Francisco in that capacity in 1946. He is very well known and has a host of friends in merchant ship and scientific research vessel fleets of many flags. A U. S. Navy veteran of World War II, he was no stranger to the sea himself, having sailed as a gunnery officer on transports in North Atlantic convoys.

A keen student of meteorology, he is the author of a Mariners Weather Log article on Tehuantepecer winds of the eastern tropical Pacific Ocean.

NEW PORT METEOROLOGICAL OFFICER AT SAN FRANCISCO

Marvin H. Hofer, a former sea-going weather man, has reported on board as the U. S. National Weather Service Port Meteorological Officer at San Francisco (fig. 28).

Figure 28.--Marvin H. Hofer.

A veteran of 4 yr of U.S. Navy service during World War II, he sailed on wartime weather patrol ships in the Pacific and also saw duty in the island campaigns in the central and southwest Pacific Ocean. After his return to civilian life, he joined the U.S. Weather Bureau in 1946 and sailed on weather ships in the Pacific for 6 yr, both on U. S. Coast Guard cutters on ocean weather station duty and on merchant vessels in the Moving Ship Upper Air Observations program. In the latter program, as supervisor, he sailed on tankers, refrigerator ships, transports, and aircraft carriers.

After assignment to shore duty in the Weather Bureau, he returned to sea duty frequently for service in new programs and special projects, including the BOMEX project of 1971 -- an international multiship meteorological and oceanographic research program in the tropical Atlantic and Caribbean.

As Port Meteorological Officer at San Francisco, he will be recruiting and servicing weather observers on ships at the many San Francisco Bay area ports and terminals, greeting old shipmates, and making many new friends.

NEW PMO AT NEDERLANDS, TEX.

Lawrence Cedotal became the Port Meteorological Officer at Nederlands, Tex., on June 19, 1975. He replaced Dave Harmon, who transferred to Abilene, Tex., as Official-in-Charge of the Abilene Weather Service Office.

Mr. Cedotal (fig. 29) has the responsibility for the weather activity of marine interests in the Beaumont-Port Arthur-Orange area, and also the Port of Lake Charles, La. In addition, he will be responsible for the visitations at the Sabine Pass and Cameron Coast Guard facilities.

Figure 29.--Lawrence Cedotal.

Mr. Cedotal transferred to Port Arthur from Apalachiola, Fla., where he served for 2-1/2 yr. Prior to that, he served at Nashville, Tenn., Lake Charles, La., and Swan Island.

BRANDY BOTTLE FOUND AFTER 27 YR AFLOAT

A barnacle-crusted brandy bottle ended a 27-yr float in the Pacific Ocean when two beachcombers found it near Reedsport, Oreg., in February.

A yellowed note inside, written in seven languages, asked the finder to send data on where the bottle was found to the U. S. Navy Hydrographic Office, now the Oceanographic Office. The paper said the bottle was dropped from the LINFIELD VICTORY off Hokkaido, Japan's northernmost island, March 6, 1948.

Mr. and Mrs. Jim Lee, Reedsport, who found the bottle, uncorked it and said it still smelled like brandy.

Earlier in February, a beachcomber found a sake bottle launched from Yokohama on the beach near Tillamook, on the Oregon coast. The note contained greetings in Japanese and wished the finder happiness and safe voyages. It was not dated.

Oceanographers say it normally takes a year or two for objects to ride the currents from Japan to the beaches of the northwest United States. Floats from Japanese fishnets are often found along the beaches, especially after storms.

Oceanographers at Oregon State University say the brandy bottle could have been circling the Pacific Ocean since it was dropped overboard. A series of Pacific currents runs in a circle from Japan to the West Coast and up through the Alaska region and back to Japan, or south to near the Equator and back to Japan.

NOAA ESTABLISHES DEEPWATER PORTS PROJECT OFFICE

A Deepwater Ports Project Office has been established in the Environmental Data Service of NOAA to meet requirements of the Deepwater Port (DWP) Act of 1974, which established procedures for the location, construction, and operation of deepwater ports off the coasts of the United States. Dr. Dail W. Brown, previously of NOAA headquarters, is heading the new office.

The DWP Act invests licensing authority in the Secretary of Transportation, while the Administrator of NOAA is to provide essential support. To meet NOAA's obligation, the EDS Project Office will review, evaluate, and prepare recommendations for the Administrator on DWP license applications, related environmental impact statements, and adjacent coastal state status.

The Act specifies that, upon petition of a state, the Secretary of Transportation shall ask the NOAA Administrator whether that state is likely to be impacted by a DWP oil spill to an extent equal to or greater than the impact on the state connected to the DWP by pipeline. The determination must be made within 45 days after a petition is received from a state. Procedures developed to evaluate the potential impact of DWP oil spills on adjacent coastal states will also be used in developing NOAA's recommendations on license applications and environmental impact statements. In addition to oil spills, other possible environmental impacts, including those that might result from the presence of physical structures, dredging of wetlands, and secondary development, will also be considered.

NOAA's DWP review activities will be fully documented and made available for public examination.

OCEAN WEATHER STATION CHANGES

There have been some more changes in the Ocean Weather Station (Ocean Station Vessel) program. The call signs have been changed from 4YA-Z to C7A-Z. In addition to the call-sign change, there have been changes in location and designation of several of the eastern North Atlantic vessels. The new positions and designations are as follows:

OWS	Position	Remarks
CHARLIE	52°45'N, 35°30'W	Reactivated by USSR.
LIMA	57°N, 20°W	Replaces INDIA and JULIETT.
MIKE	66°N, 02°E	No change.
ROMEO	47°N, 17°W	Replaces KILO.

SEA ECHO: SKYWAVE RADAR MONITORS DISTANT SEA STATE

Scientists are monitoring distant sea conditions in the North Pacific for the first time, with a specially designed skywave radar that has just begun test operations off the coast of California. Project scientists say that, if the year-long tests of the over-the-horizon system are successful, operational versions of it could speed ships in their transoceanic cruises and save ocean-related industries tens of millions of dollars a year.

This high-frequency radar is a key element in a cooperative research study, known as SEA ECHO, which is being conducted by the Naval Research Laboratory (NRL), Washington, D.C., the National Oceanic and Atmospheric Administration (NOAA), and the Institute of Telecommunication Sciences (ITS), both in Boulder, Colo.

The target area of the first research study is the Gulf of Alaska, selected for its severe and changeable weather, and its role in American energy plans. The Gulf will be crossed by the sea leg of the Trans-Alaska Pipeline, and proposed oil-leasing areas on the Alaskan continental shelf are the subject of an intensive environmental study being conducted by NOAA for the Interior Department's Bureau of Land Management.

Specifically, the radar-scanning technique employed is capable of helping scientists:

(a) Predict destructive wave activity along the northwest coast of America.
(b) Infer average wind conditions near the ocean surface for the prior 6- to 24-hr period.
(c) Improve warnings to coastal areas and ships likely to be damaged by the waves.
(d) Predict where and when high waves will reach other regions.

Weather- and sea-condition data will be sent for

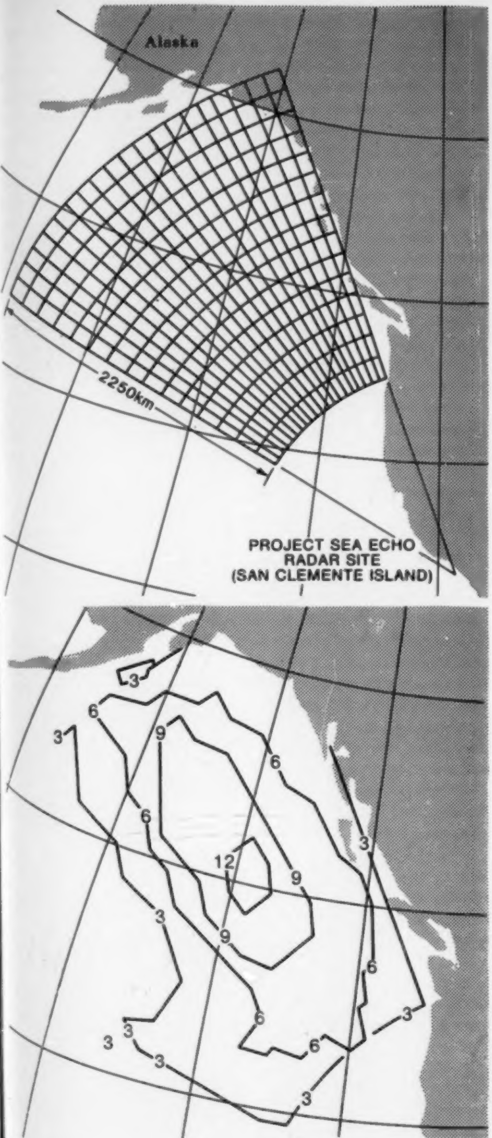

Figure 30. -- The antenna pattern is shown at the top, and a representative wave-height contour map at the bottom.

analysis to the Navy's Fleet Numerical Weather Central, in Monterey, Calif., and the National Meteorological Center of NOAA's National Weather Service, near Washington, D.C. The Fleet Numerical facility and the NMC employ automated computer models of global weather which tie together inputs from many sources and produce sea-state and weather predictions. The Navy now uses Fleet Numerical predictions for optimum ship routing for savings in transit times and fuel costs. (See January 1975 issue of the Mariners Weather Log.)

Remote areas such as the North Pacific are sparsely measured, and the SEA ECHO data are expected to have a high potential in supplying needed information. Navy and NOAA scientists will test the radar data against the computer-generated models for a year or more to determine its reliability and accuracy before using it in real-time predictions.

The SEA ECHO radar, resembling a monster radio station more than a typical radar, stands on a rocky shoreline at the north end of San Clemente Island, 90 mi off the California coast. The prominent antenna consists of a quarter-mile-long row of 150-ft towers and a spider web of antenna wires. The sophisticated electronics and a full-size computer are housed in trailers.

From its perch on the north end of the island, the antenna, 1,200 ft long by 400 ft wide, scans a 1,550-mi-long sector of the North Pacific Ocean and Gulf of Alaska. The radar's signals will be able to observe the coasts of California, Oregon, Washington, and British Columbia, as well as a wide section of ocean in the Gulf of Alaska. The SEA ECHO radar will also be able to "zero in" on any of 400 designated 80-by-80-mi patches of ocean within the antenna's range--as far away as the westernmost tip of the Aleutian Island chain (fig. 30).

Unlike the familiar microwave radars operating with short wavelengths and "dish" antennas, the novel radar employed in this project uses very long wavelengths. At these long wavelengths, signals are reflected by the ionosphere to great distances over the horizon. (This phenomenon is familiar to motorists whose AM radios can pick up far-distant stations, particularly at night.) However, the most important aspect of the long radio wavelengths used is that they exactly match the wavelengths of the ocean. The use of this effect makes the SEA ECHO system very sensitive to the conditions of the sea. Some of the sea-scattered radio energy returns to the radar over the same path. A computer at San Clemente records the time delays for the echo return as well as the echo frequencies, and analyzes the way the returning echo has been scattered at the ocean surface. From this information, the computer produces contour-line maps showing differing wave heights, directions, and periods within the region scanned, with as little as 1-1/2 hr of echo observations.

ADDRESS CHANGES

There have been problems in maintaining the correct addresses of ships on the various mailing lists. Address changes for "Notice to Mariners" and "Pilot Charts" should be forwarded directly to the Defense Mapping Agency (DMA), utilizing the "tear-out" on the mailing page of the "Notice to Mariners." Vessels receiving only "Pilot Charts" should notify the DMA office in Washington, D.C., or one of the depots (in Philadelphia, Pa., and Ogden, Utah) of their new address.

Ships' address changes for the Mariners Weather Log should be sent to the address on the inside of the front cover of the magazine, or to any of the Port Meteorological Officers.

In any case, the old name and address should be indicated so it may be deleted, and, if possible, the reason for the change or deletion.

SAVING LIVES IN THE PACIFIC

The following is courtesy of Sealift, April 1975.

Despite strong winds and heavy South Pacific seas, 23 people abandoning the sinking BRITISH AMBASSADOR (fig. 31) were pulled to safety by crewmen of the Military Sealift Command-chartered tanker FORT FETTERMAN.

The FORT FETTERMAN, enroute from Guam to Sasebo, Japan, with a full load of JP-4 jet aircraft fuel, sailed 110 mi off her course to aid the tanker. Water had been flooding the BRITISH AMBASSADOR's engineroom since noon, and she was powerless. All pumps were out.

AMBASSADOR's motor lifeboat, carrying the first load of evacuees, nearly capsized during the January rescue, about 100 mi west of Iwo Jima. Rough seas and gale winds prevented 11 more persons from crossing to the safety of the FETTERMAN.

Arriving at the scene January 10 at 9 p.m., the FETTERMAN found the tanker listing to starboard, and her stern slowly sinking. Because of 30-kn winds and heavy seas, and the fact that there was no immediate danger of sinking, the master waited until daylight to transfer his passengers.

At 7 a.m. the next day, AMBASSADOR's lifeboat (cover) was launched, carrying 23 of the 51 people on board. Once the lifeboat was alongside the FETTERMAN's port side, nine people climbed aboard before the ship drifted out of AMBASSADOR's lee. Waves crashed over the rescue ship's starboard side, across the deck and into the lifeboat (fig. 32), throwing two people into the water and drowning the boat's motor. The two people flung into the ocean scrambled back into the lifeboat with the help of FETTERMAN crewmen.

Since the lifeboat's oars had been swept away, the FETTERMAN's captain had to maneuver alongside the boat. Only three more people were able to scramble aboard before the boat broke away and drifted clear of the rescue ship.

The captain moved alongside the lifeboat for the third time. A seaman climbed down into the boat, secured it, and helped the passengers aboard. Others

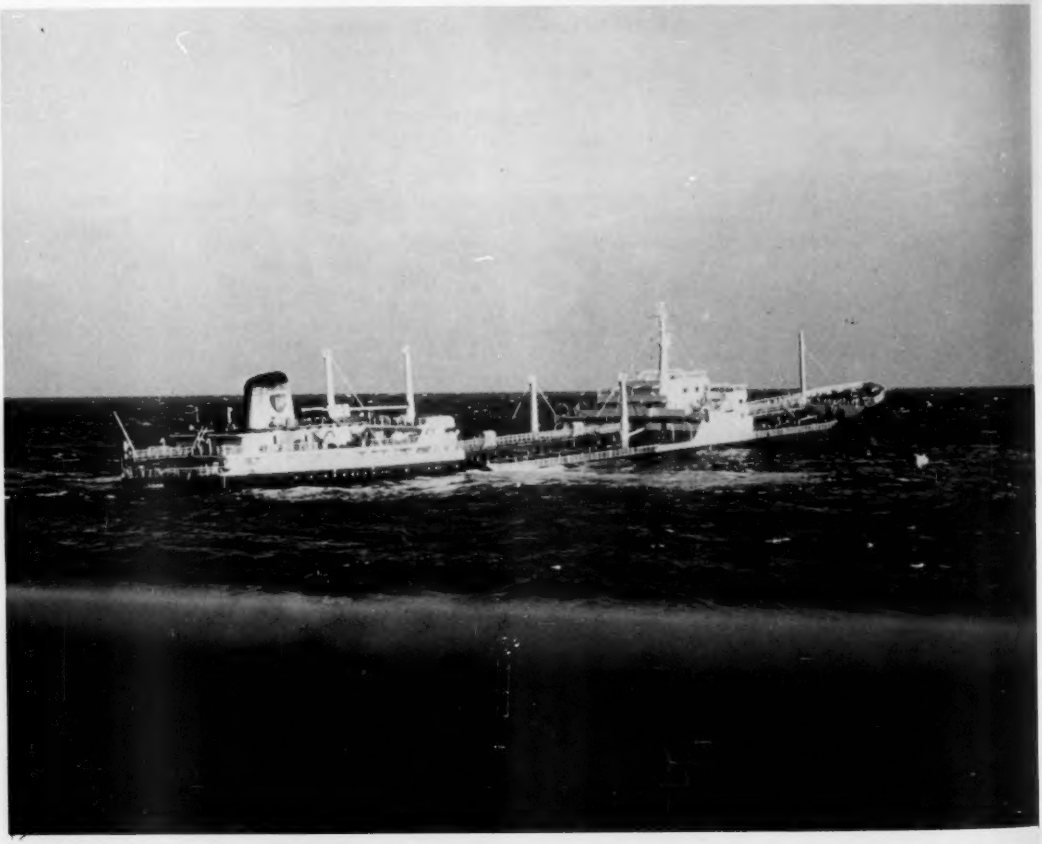

Figure 31.--The AMBASSADOR settles by the stern, with the FETTERMAN standing by to aid in the rescue. The lifeboat can be seen off the bow, and a rescue aircraft can barely be seen above the bow. Photo courtesy of Sealift.

Figure 32.--The waves are washing over the deck of the FETTERMAN and hampering rescue from the lifeboat. Photo courtesy of Sealift.

also went over the side to help those who missed the net or ladder and fell into the water. From the deck, the chief mate helped organize and direct the rescue operation.

After the rescue, FETTERMAN crewmembers offered their sleeping quarters to those rescued and slept on the decks themselves. Two AMBASSADOR officers and their wives were provided rooms in the ship's hospital during the voyage to Sasebo, where all of the survivors disembarked.

One FETTERMAN crewman sustained serious back injuries during the rescue and was flown to the United States for hospitalization. He was injured diving into the sea to aid the wife of an AMBASSADOR officer. The woman had been thrown into the water when waves swamped the lifeboat she was in.

The AMBASSADOR sank shortly after the German salvage tug ARCTIC, which arrived the evening of the 11th, removed those remaining on the stricken ship.

Letters of commendation were presented to FETTERMAN crewmen aboard ship in Ozol, Calif., in March.

NOAA DIVING MANUAL CONTAINS BASIC INFORMATION FOR UNDERWATER INVESTIGATIONS

Publication of a diving manual designed to guide divers in shallow-water work--down to 300 ft--has been announced by the National Oceanic and Atmospheric Administration. Called "NOAA Diving Manual: Diving for Science and Technology," the publication was prepared primarily for the nearly 300 divers within the Commerce Department agency. However, it contains basic, up-to-date information on the diving technology required to carry out scientific investigations and other working-diver tasks, and is expected to be of use to scientific and working divers throughout the world. It is designed to provide divers with the knowledge needed both for safe and efficient diving, and for carrying out useful scientific research.

Early sections of the almost-500-page manual deal with basic diving physics and physiology, diver training, equipment, breathing media, and procedures. Special topics include diving under varied conditions, such as under ice and in rivers and lakes, air diving, and saturation diving. An up-to-date chapter on ma-

rine animals hazardous to divers is also included.

One section of the manual is devoted to scientific diving procedures and covers a wide variety of operations ranging from underwater surveying and photogrammetry to biological surveys and sampling, shellfish capture, geology, microphysical oceanography, and archeological diving. Capture techniques, including the use of anesthetics in obtaining marine specimens, are treated in detail.

Prepared by NOAA's Manned Undersea Science and Technology group, the manual was extensively reviewed and includes contributions by 58 experienced scientific and operational divers from universities, Federal and State agencies, and private organizations throughout the United States. Much of the information in the manual has never before been published. The work is illustrated with diagrams, sketches, and photographs designed to help the user understand the techniques and procedures discussed. Warnings regarding safe diving procedures are highlighted in red throughout the book.

The NOAA Diving Manual is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402, at a cost of $8.55. The stock number is 003-017-00283.

ORTHOPHOTO CHARTS ISSUED BY NOS

An orthophoto nautical chart for Miami harbor, with land areas adjacent to coastal waters shown by reproductions of aerial photographs, has been published by NOAA's National Ocean Survey. This and similar charts published for Ft. Pierce and Ft. Lauderdale are the first of their kind to be issued in the United States (fig. 33).

On previous charts, the land areas were shown only by a buff tint outlined with a black line representing the shoreline. The new charts provide more land details to assist mariners in determining their positions at sea, and also to assist the Coast Guard in fixing the positions of navigational aids.

A process known as orthophotography removes distortions caused by the tilt of the aerial camera and by varying ground elevations. It produces a precise photograph of the Earth's surface in which all features appear in their correct horizontal positions, including highways, streets, and prominent structures. The orthophoto format eliminates the painstaking hand drafting and scribing by cartographers of intricate land details, such as roads, buildings, contours, and other landmarks.

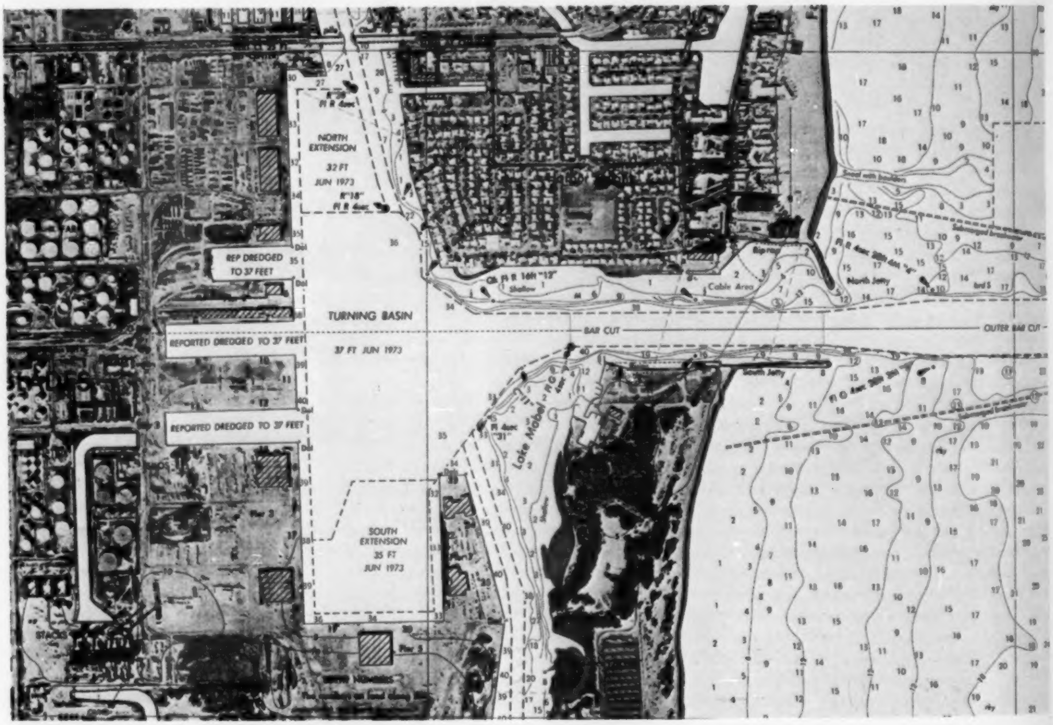

Figure 33.--Orthophoto chart of Port Everglads clearly shows the details of the land area.

MARINE WEATHER REVIEW

The SMOOTH LOG (complete with cyclone tracks [figs. 35-38], climatological data from U.S. Ocean Station and Buoys [tables 5 and 6], and gale and wave tables 7 and 8), is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The ROUGH LOG is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both the SMOOTH and ROUGH LOGS, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

Smooth Log, North Atlantic Weather

March and April 1975

SMOOTH LOG, MARCH 1975--There were vast differences in the monthly mean weather patterns of February and March. The February pressure centers were much more intense than the climatological average and the March mean. This did not necessarily apply, though, to an individual storm that the mariner may have encountered. Last month, high pressure over Europe diverted storms northward, while this month, the English Channel and Iberian Peninsula were favorite paths.

Cyclone tracks over eastern North America and off the East Coast were relatively normal in number and location. According to climatology, they converge near Newfoundland and then branch toward either Kap Farvel or Iceland. This month the track toward Iceland was diverted east- and southeastward into Europe.

The major difference in the mean pressure from climatology was a 1010-mb Low over central Europe and the Ligurian Sea, rather than a 1017.1-mb High. The High center was many miles to the southeast over eastern Libya. The 1002-mb Icelandic Low was near 57°N, 48°W, and about 10° longitude west of its 1005.3-mb climatic position. A ridge from the 1022-mb Azores High extended northward west of Europe.

There were four significant anomaly centers. A negative 5-mb center was located between Labrador and Kap Farvel. A negative 7-mb center was over northern Italy. The ridge produced a positive 5-mb center west of Ireland and south of Iceland, and a positive 4-mb center was near the Canary Islands.

The upper-air pattern was near normal except for more intense ridging off western Europe and a sharp trough over central Europe. The Low centered near Kap York, Greenland, was deeper than normal, resulting in a steeper north-south gradient.

Extratropical Cyclones--This storm formed southeast of the Grand Banks, early on the 1st, in a trough left behind by a previous LOW. It developed rapidly in the wake of another LOW about 24 hr ahead. At 1200 on the 1st, the EVELYN BOLTEN was headed northeastward with 50-kn winds on her port side. Between the two LOWs, the ARES and ORCOMA both contended with 45-kn gales, with the former reporting 16-ft seas and 25-ft swells. Twelve hours later, the BOLTEN was still battling 50-kn winds. By midday on the 2d, the LOW was 964 mb near 50°N, 24°W. The ATLANTIC CHAMPAGNE was headed southwestward near 47°N, 30°W, and being hammered by 60-kn northwesterly winds driving 39-ft seas. To the east, the DART AMERICA (47°N, 25°W) was sailing with 50-kn westerly winds on her stern and being rocked by 13-ft seas and 23-ft swells. The BUNTENTOR and AMERICAN ACCORD, both along 45°N, fought 45-kn gales and seas up to 33 ft. The LIGHTNING, at 48.8°N, 23.2°W, was engulfed by 50-kn winds, 15-ft seas, and devastating 41-ft swells.

At 0000 on the 3d, the DART AMERICA (47°N, 20°W) and the VAUCLUSE (47°N, 18°W) both battled 60-kn westerly winds. For that speed winds, the waves were a relatively mild 20 ft. As the storm approached Lands End, on the 4th, it was weakening, but, at 0000, there were reports of 23- and 30-ft swells west of the Bay of Biscay. The Greek motorvessel ARPA SUN arrived at Cork, on the 5th, with heavy-weather damage sustained on the 4th, during battering force-10 winds and 30- to 35-ft waves. On the 5th, the LOW had deteriorated to a trough moving into Scandinavia.

A large storm that had developed off Norfolk, on the 2d, was north of Newfoundland on the 4th. At 1200 on the 3d, the AMERICAN COURIER found 50-kn winds and waves of 25 ft off Nantucket Island. A small circulation developed in the col area between that storm and the one previously described. As this new LOW moved over Iceland, late on the 5th, another LOW developed near 56°N, 26°W. By 0000 of the 6th, it was becoming the primary cyclone as the older ones on both sides weakened. At 1200, the 958-mb LOW was near 60°N, 18°W, and Ocean Weather Vessel "I" measured 60-kn storm winds from the west. The ship was also being tossed by 26-ft seas and 20-ft swells 30° off the wind. Twelve hours later, the winds decreased to 35 kn, but the seas were still 23 ft and "J" was now measuring 23-ft swells. As the storm moved into the Norwegian Sea, it was slowly moving northeastward. Far to the south, between 45° and 50°N, and near 35°W, ships were reporting winds to 45 kn, as a minor trough

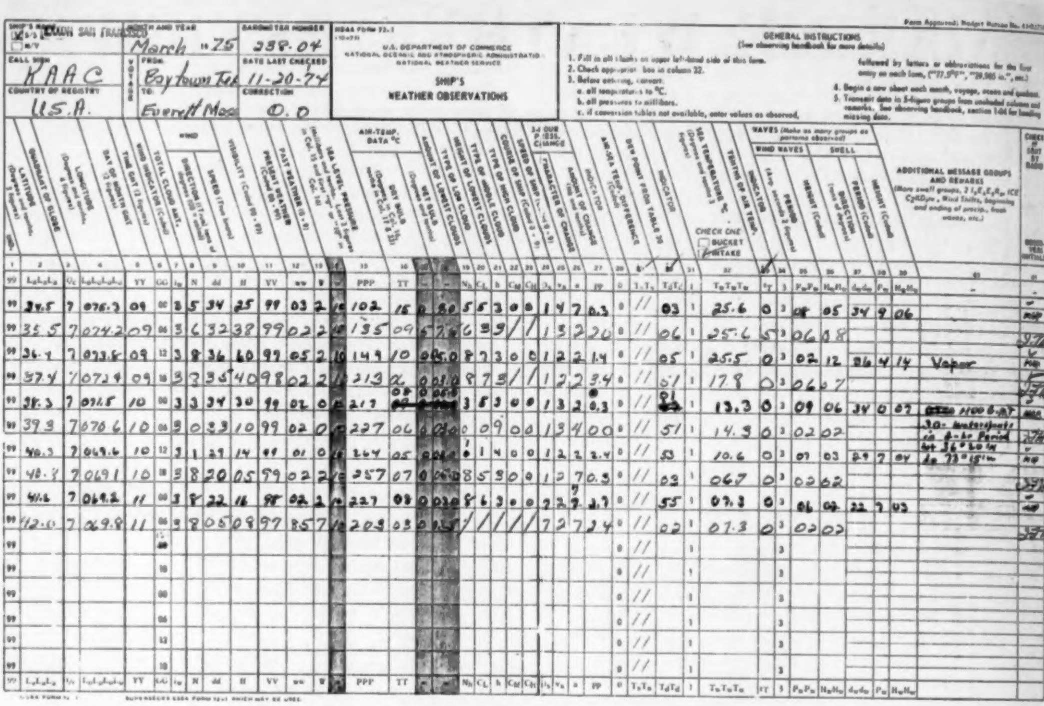

Figure 34.--The Ships' Weather Observations form from the EXXON SAN FRANCISCO.

moved through the area.

At 0000 on the 8th, a LOW had formed in the trough and was moving toward Brest. At 1200, the SYLVO was near 46°N, 13°W, with 60-kn winds. Nearby, Ocean Weather Station "K" was suffering 45-kn winds and seas of 43 ft. Farther west (44°N, 22.5°W), the SEA-LAND PRODUCER had 40-kn winds and 25-ft swells. The SEA-LAND ECONOMY had 33-ft swells at 48.1°N, 12.7°W. Both storms moved out of the area of interest on the 10th.

Figure 34 shows the "Ship's Weather Observations" form from the EXXON SAN FRANCISCO for March 9 and 10. The "Remarks" column is of considerable interest: "1100 GMT 30 waterspouts in 2-hr period, lat 36°20'N, long 73°15'W." Although entered starting on the 10/0000 line, the reference is to the 9th, according to their position reports.

The meteorological situation was as follows. A LOW had moved eastward south of the Great Lakes and north of the Ohio River, turning northeastward along the New England coast. At 1200 on the 9th, the LOW was over Newfoundland. A large cold HIGH was centered over Indiana. A cold front out of the LOW had moved off the coast, about 0600 on the 8th, and, at 1200 on the 9th, arced from Havana to about 29°N, 65°W, to a wave at 38°N, 58°W, and then a sharper arc to St. John's. The wind flow west and north of the front and off the coast was north to north-northwesterly at 25 to 35 kn, according to most synoptic reports. On the 9th, the 1200 report of the EXXON SAN FRANCISCO was not plotted. That report was northerly winds of 60 kn at 36.4°N, 73.8°W. The seas were 20 ft and the swells 23 ft, from the north.

The air temperature was 10°C, and the sea temperature, 25.5°C -- over 15°C difference. Nearby, EB-01 reported a 20°C temperature difference, and OWS HOTEL, an 11°C difference. These differences would result in great instability along the Gulf Stream, which was indicated by the cumulus-type clouds reported by other ships, and by the numerous waterspouts sighted by the EXXON SAN FRANCISCO. (See the article, "Dangerous Waves Along North Wall of the Gulf Stream," in the November 1974 issue, Volume 18, Number 6.)

A cyclone that developed on the Gulf Coast, on the 13th, was over the mountains of West Virginia, late on the 14th. At that time, another LOW developed off Wallops Island, Va. Almost immediately, there were gales blowing south and east of Cape Cod. At 0000 on the 15th, the EXXON SAN FRANCISCO, at 33.2°N, 77.8°W, reported roaring 70-kn winds from the south-southwest, ahead of the cold front. The storm moved northeastward and was near Sable Island, at 0000 on the 16th, with a pressure of 994 mb. Gale winds were blowing in all quadrants. The VERCONELLA was plotted near 40°N, 58°W, with swell code 43 (71 ft). Other ships in the area were reporting swell code 12 (20 ft), so the code possibly should have been 13. The AMERICAN ALLIANCE had 15-ft seas and 26-ft swells, near 38.3°N, 56°W, at 1800.

Gales of up to 45 kn and waves up to 28 ft continued to be reported south of the storm center as it moved east of Newfoundland. At 1200 on the 17th, the C. P. TRADER was 400 mi south of the 976-mb center with 45-kn winds. Later, at 0000 on the 18th, the AVON FOREST (46°N, 38°W) was washed by 50-kn wind-driven rain and battered by 33-ft swells. Twelve hours later, the MONT LOUIS was tossed by 30-ft swells near 49°N, 42.5°W. The AMERICAN ARCHER (45.1°N, 33.2°W), at 1800, battled a 55-kn storm and 30-ft seas. The LOW was now tracking northward and dissipating, as the next storm approached from the south.

This was a good example of the almost explosive development of a storm over or near Cape Hatteras. At 0000 on the 17th, there were indications of a frontal wave off South Carolina. At 0600, there was a center over Pamlico Bay, and at 1200, a well-developed circulation at 36°N, 74°W. By 0000 on the 18th, the 1000-mb LOW was near 36°N, 67°W, and Ocean Weather Station "H" measured 40-kn winds and 20-ft seas.

The storm was moving between the Azores High and a HIGH moving over New England from Canada. This gave the storm an oval shape. The INVERNESS was north of the cneter, at 0000 on the 19th (40°N, 44°W), with a 40-kn nor'easter, 25-ft seas, and 30-ft swells. In the next 12 hr, the gradient tightened on the western side of the LOW, as it was squeezed between the HIGHs. The NORSE PILOT (35°N, 47°W) was only a few miles from the 994-mb center and fighting 60-kn winds. Thirty-foot swells and 25-ft seas were still being observed north of the storm. At 0000 of the 20th, the VICTORIA CITY radioed 55-kn winds in the same position relative to the center as was the NORSE PILOT earlier, and reported 33-ft waves.

Between 0000 and 1200 on the 21st, the ZARIA and the 984-mb LOW crossed paths in the vicinity of 38°N, 36°W. Her wind shifted from southerly to northeasterly, with seas and swells between 20 and 26 ft. On the 22d, the LOW was being pushed and pulled toward the northwest as the Canadian HIGH moved south of it, and a LOW was moving eastward south of Newfoundland.

Another East Coast storm! It was causing grief to shipping off the coast as the center passed over the Nation's Capital, late on the 19th. About that time, the MORMACCAPE was at 34.6°N, 74.8°W, with 45-kn winds, 15-ft seas, and 41-ft swells. At 0000 on the 20th, the CARBIDE TEXAS CITY was east of the center, near 38°N, 73°W, with 45-kn southeasterly winds, and Ocean Weather Station "H" measured 45 kn also, but added 26-ft seas. The TRANSHAWAII, off Cape Hatteras (33.6°N, 74°W), was sailing southeastward with 40-kn southwesterly gales, 33-ft seas, and 49-ft swells from the southeast.

As the storm moved over Long Island at 1200 on the 20th, HOTEL measured a piddling 10-kn wind and 3-ft seas, but the swells were 26 ft out of the south. For an East Coast storm, this one was moving northeastward at a leisurely pace. It was 988 mb over the Bay of Fundy, at 1200 on the 21st. An Estonian ship was blown by 55-kn storm winds south of Nantucket Island. The winds had picked up to 35 kn at HOTEL, but the waves had held at 25 ft. On the 22d, the HAHNENTOR, at 36°N, 61°W, was racing 33-ft swells. She wasn't the only one fighting high seas; the SULTANA, at 39°N, 59°W, at 1200, was plowing into 40-kn winds with 30-ft waves.

This was the last of the severe conditions that this LOW was reported to have contributed to mariners. It continued on an erratic track toward the English Channel, which it entered on the 27th.

There was just a hint of the formation of this LOW, on the 0000 chart of the 30th, over Maryland. The LOW moved along the coast, and, at 0000 on the 31st, the 982-mb storm was on the Nova Scotia coast. Along the way, Ocean Weather Station HOTEL measured 44-kn winds and 17-ft seas. Three ships reported high winds of 50 and 55 kn, between 40° and 43°N, and 58° and 66°W. The AMERICAN LEADER topped them all with 55 kn, and 33-ft swells.

At 1200 on April 1, the 960-mb LOW was off Hopedale, on the Labrador Sea. Its circulation stretched far to the south, and the AMERICAN LEADER was still being pounded by 47-kn winds and 33-ft swells in the vicinity of 40°N, 59°W. The LOW continued moving up the Labrador coast and dissipated over Ungava Bay.

Casualties--The Dutch ATLANTIC CROWN (15,469 tons), Baltimore for Havre, struck an iceberg, on the 19th, while approximately 350 mi southeast of St. John's, with damage to the stem and a crack in the forepeak. The IRISH CEDAR (10,477 tons) reported leaking of the number 1 hold due to ice damage off Anticosti Island. The 1,599-ton Norwegian BRUIN sank 30 mi off Karlskrona, on the 6th, after a collision in fog with the NORTHERN FROST. One person died, and one was missing. The British trawler D. B. FINN (701 tons) grounded on south Iceland in strong winds on the 21st.

SMOOTH LOG, APRIL 1975--It appears that the place to start the discussion of the marine climate for this month is with the mean pressure pattern. According to climatology, the 1007.5-mb Icelandic Low is centered near Kap Farvel. The overall pattern is a gourd shape extending into the Norwegian Sea, with a minor Low in that area. This month, that pattern was shifted 1,100 mi to the southwest. The main Low (1008 mb) was centered near Sydney, Nova Scotia, with the same shape extending northeastward with two minor Lows, the northern one being about 200 mi east of Kap Farvel. The mid-Atlantic High, at 1026 mb, was shifted northeastward to near 43°N, 22°W, from its 30°N, 40°W, climatic position at 1021 mb. The High that is normally north of the Queen Elizabeth Islands was shifted southward to northern Hudson Bay, at 1028 mb. These shifts resulted in large anomalies, which will be discussed later.

Without getting into the argument of which came first, the chicken or the egg--whether the pressure pattern is a result of the storm tracks or vice versa--the storm tracks were also misplaced, although not as much as the pressure pattern would indicate. The Hudson Bay, Davis Strait, and Baffin Bay area was almost devoid of storms. The LOWs originated over the central United States rather than being evenly divided between there and central Canada. Many of these were diverted southward over the New England

States, rather than along the St. Lawrence River. Storms off the U.S. east coast tended to form farther out at sea and moved more eastward, prior to turning northward toward Iceland, and then into the Norwegian Sea. No storms tracked across southern England, nor out of the Bay of Biscay into the Mediterranean Sea, as is usual.

As would be expected from the previous discussion, there were several large, important anomaly centers, three positive and one negative. The negative, a minus 5-mb, was centered near 40°N, 60°W. From west to east, the positive centers were an 11-mb over northern Hudson Bay, an 8-mb over central Greenland, and a 9-mb near 45°N, 25°W.

In the upper air, the Polar Low was nearly normally located, with the pressure surfaces slightly lower. Normally a trough exists down Baffin Bay and along the U. S. east coast. This month, the trough was accentuated, and a LOW was centered over the Gulf of St. Lawrence. This resulted in a much tighter gradient over the western ocean. The ridge normally over western Europe was greatly accentuated and farther west, near 20°W. The anomaly patterns closely paralleled those at sea level except over Greenland, where the sign was reversed.

There were no tropical cyclones, and none would be expected, as there is no record of any as far back as 1886.

Extratropical Cyclones--Monster of the Month--The first significant storm of the month originated over the Texas-Oklahoma border on the 2d. It deepened very rapidly as it moved up the Ohio River Valley. On the 3d, at 1200, it was 980 mb over Buffalo, N.Y., and southeasterly gales were blowing off the East Coast. Twelve hours later, it was 972 mb near Boston. At 0300 on the 4th, the USCGC TANEY was at 37.3°N, 72.4°W, measuring a 55-kn storm with 23-ft seas. The WILMINGTON GETTY had 60-kn winds nearby (37.3°N, 73.8°W), and 23-ft seas also. Other ships that reported 40- to 50-kn winds that day, from the storm, were the ALERT (30-ft waves), AMERICAN ALLIANCE (30-ft waves), CHANCELL ORSVILLE, EXXON BANGOR, and OGDEN THAMES. The CARBIDE TEXAS CITY, at 32°N, 72°W, came in with 50-kn winds. Northeast of the center, the HUDSON, off lower Nova Scotia, was also battered by 50-kn winds. The COLON BROWN (15,471 tons) returned to Halifax Harbor, on the 3d, and grounded on Lighthouse Bank during high winds. Two barges sank at Newport News.

The 13,322-ton Liberian tanker SPARTAN LADY broke in half, about 120 mi southeast of Montauk Point, N.Y., in heavy seas on the 4th. Ships in the vicinity, including the OROTAVA, PHILINE, and ERET, reported 23-ft seas or swells. Coast Guard helicopters rescued the crew, but one died, reportedly of a heart attack. The helicopter crew reported 80-kn winds in the area. The stern section sank, but the bow section had to be sunk by the Coast Guard.

At 1200 on the 4th, there were many 40- and 45-kn winds. The TANEY again reported 50-kn winds, as she headed toward Norfolk. The KASTAN reported 60-kn winds near 32°N, 67°W, near the same relative position, but farther east, where earlier the CARBIDE TEXAS CITY had reported 50-kn winds. Seas and swells of 15 to 23 ft were being reported. At 0000 on the 5th, the EXXON BANGOR was headed northward off Cape Charles with 50-kn winds and 36-ft swells. Nearby, the BAYANO appeared to be headed into Delaware Bay with 45-kn northwesterlies on her starboard side. The AUSTRAL ENTENTE put into Charleston, S.C., because of shifted cargo.

This was the worst storm of this winter-spring season for the U. S. east coast. Snow, floods, and high winds paralyzed many areas. Drifts as high as 5 ft were reported in northern New England. Many thousands of homes were without electricity. Airports were closed; National at Washington, D. C., measured gusts to 57 kn. The northwest winds resulted in the lowest water levels on Chesapeake Bay and the Potomac River since 1908.

On the 5th, the LOW, at 986 mb, had split into double centers. Gales were still blowing in the southwest quadrant. The PHILINE (35°N, 67.5°W) estimated only 40-kn winds, but 20-ft seas and 39-ft swells must have been hard to mistake. The MOBIL AERO fought 60-kn winds and 20-ft seas, near 37.9°N, 71.4°W, at 1800. The wind was still 55 kn at 0600 on the 6th.

By 0000 on the 6th, the LOW once again had a single center, and its circulation extended eastward to 35°W, and from 24° to 57°N. The reported winds had decreased to a minor 35 kn. The LOW was now headed northward and filling. It moved over the Gulf of St. Lawrence on the 8th, and dissipated on the 9th.

A frontal wave formed in an area of weak gradient off the Carolina coast, late on the 10th. It quickly wound up and, by 0000 on the 13th, was a small 990-mb storm rolling northeastward. The SOYO MARU was due south of the center (41°N, 53°W), near 37.5°N, 53°W, with 45-kn gales. The storm continued racing northeastward with only slight deepening. At 1200 on the 14th, the 982-mb LOW was at 53°N, 28°W. The SCHIROKKO was fighting 55-kn bow winds, near 47.5°N, 27°W, with 13-ft seas and 15-ft swells, 20° off the wind. On the 15th, the storm turned eastward and then southeastward, to disappear over the continent on the 16th.

A Cape Hatteras Storm! At 1200 on the 15th, a 1001-mb LOW was directly over Cape Hatteras, having first been identified 6 hr earlier over South Carolina. The TRANSHAWAII was sailing up the coast with 40-kn winds and 20-ft waves. Twenty-four hours later, the 990-mb storm was near 38°N, 68°W, with gale-force winds in all quadrants. The R. G. FOLLIS, at 37.3°N, 67.6°W, was ravaged by 60-kn winds and 49-ft seas,

according to a 1300 special observation. Later, at 1800, the MORMACDRACO (34.4°N, 69.4°W) was also tossed by 49-ft waves.

By 0000 on the 17th, the central pressure had plunged to 976 mb near 39°N, 65°W, and the winds were howling. The R. G. FOLLIS was south of the center, at 36°N, being ravaged by 60-kn winds, 41-ft seas, and 46-ft swells. The ERET was practically in the center with 40-kn southerly winds and 30-ft seas. About 200 mi north of the center, the CHERNOMORSKAJA SLAVA was pounding into 50-kn winds and 20-ft seas. The MORMACDRACO's winds had dropped to 40 kn, but the swells were still reported at 49 ft.

The storm was moving very slowly, and its circulation expanding. Gale-force winds and high seas were the rule. The FOLLIS was now near 36.5°N, 68°W, with 45-kn winds on her port side, which was being hammered by 41-ft seas and 49-ft swells.

The storm was headed toward Cape Race, which it passed at 1800 on the 18th, leaving gale-whipped ships in its path. The storm was now losing most of its punch over the cold water off the Labrador Sea and was gone by the 21st.

This LOW split off another LOW that had formed earlier over the central ocean and moved northward and then westward to Greenland. It split off early on the 18th, near 55°N, 25°W, at 978 mb. It immediately treated the RYBATSKAJA SLAVA to 40-kn winds and 16-ft seas. At 1200, Ocean Weather Station JULIETT had 40-kn gales, 28-ft seas, and 20-ft swells. A SHIP near the LOW was hammered by 50-kn winds as it sailed southwestward. The LOW, which had now filled to 996 mb, moved south of INDIA, early on the 19th, leaving two ships south of her with 40-kn memories.

It appeared that the storm was about to die out as its center moved toward and north of the Faeroe Islands, but, at 0000 on the 20th, it hit the Shetland Islands with 50-kn winds. The storm disappeared over the Greenland Sea on the 22d.

The history of this storm is slightly different from most. As in many cases, it developed as a wave on a front, but in midocean rather than near shore or over land--near 43°N, 45°W, at 0000 on the 23d. It moved rapidly northward as a wave, with little development until the 24th. At 1200, it combined with a nearly stationary LOW that was over southern Greenland and had originated over the midwestern United States many days earlier. On the 25th, the combined system moved into the Denmark Strait. This usually dooms a system, as it either dissipates or continues into the Greenland Sea. During this time, only minimum-level gale-force winds were reported.

A closed upper-air LOW was centered over southern Greenland, on the 26th, as the surface LOW made a counterclockwise loop and moved southward to 63°N. By the 27th, the upper-air system had deteriorated to a trough and was moving eastward, as was the surface LOW. It was still a very weak storm (1008 mb), but gale-force winds were now blowing south of the center.

At 0000 on the 28th, the central pressure had fallen to 990 mb, and THALASSA, near 57°N, 20°W, was battered by 45-kn winds and 26-ft seas. At the midday observation, Ocean Weather Station INDIA measured 40-kn northwesterly winds and was mauled by 26-ft seas and 30-ft swells. The ASIA FREIGHTER, 400 mi south at 53°N, 21°W, also had 40-kn gales, but the waves were not nearly as high.

At 1200 on the 29th, the 976-mb LOW was south of the Faeroe Islands and about to turn north- and then westward again. At that time, the MULAFOSS was midway between Iceland and the Faeroe Islands, with biting 1°C, 60-kn storm winds. To the south, 40- and 45-kn winds were observed. The OTHELLO was off the northeastern coast of Iceland, on the 30th, with 45-kn gales of -5°C.

The center of the LOW brushed the southeast coast of Iceland, on the 30th, with gale winds at coastal stations. It turned eastward again, on May 1, to visit OWS INDIA again with 35-kn gales and waves to 20 ft. This time the LOW continued east-northeastward over northern Scandinavia.

This last storm of the month didn't really develop until May. The western ocean off the U. S. east coast was an area of flat pressure gradient between two large HIGHs. A weak 1011-mb LOW was indicated, on the 29th, by widely spaced ship reports. It drifted eastward, with indications of three weak centers, on the 30th. By May 1, the Bermuda High had moved westward, and two low centers were well defined by the circulation and ship reports. By this time, the primary center had dropped to 992 mb, and gale winds were being reported. At 1200, the TRENTWOOD, at 45°N, 52.5°W, was headed into howling 45-kn gales. The AMERICAN ALLIANCE, at 42°N, 56°W, had 40-kn winds on her starboard side and was being battered by 20-ft seas and 25-ft swells.

At 1200 on the 2d, the SKAFTAFELL was just off Cape Race with 50-kn winds, as the 984-mb LOW made a loop over the Grand Banks. Winds of 35 and 40 kn were reported southwest and east of the center. On the 3d, the MANCHESTER ZEAL, at 42°N, 54°W, was rocked by 25-ft swells on her port side. Farther north off Cape Race, a ship had 26-ft seas. On the 4th and 5th, the LOW traveled due north along the 37° meridian to the King Frederik Kyst, where it again circled. At 1200 of the 5th, a ship radioed a 55-kn observation near 61°N, 24°W, with 26-ft seas. The LOW weakened on the 6th and 7th, as it continued to pound the Greenland coast.

Casualties--The Italian motorvessel ATREO (8,687 tons) was taken to Halifax by the tug POINTE MARGUERITE, after being disabled in ice in Cabot Strait on the 3d. The 9,244-ton British-registered CARREL reported being icebound, about 50 mi west of Newfoundland, on the 7th.

The oil-prospecting ship COMPASS ROSE III disappeared north of Scotland, with a crew of 16. British rescue ships and aircraft made a massive search without finding them.

The 559-ton Spanish-registered ASTILLEROS GONDAN II sank in heavy weather off the Canary Islands on the 8th. One crewmember of 12 survived. The 643-ton Panamanian VERMONT sank, on the 27th, off Cape Canaveral, after the cargo shifted in heavy weather. Coast Guard efforts to keep the vessel afloat failed. The Greek tanker LEADER COLOCOTRONIS (12,773 tons) collided in fog with the German HUBERTGAT (499 tons), near latitude 52.5°N, longitude 03.5°E, on the 27th. Both suffered damage.

Smooth Log, North Pacific Weather

March and April 1975

SMOOTH LOG, MARCH 1975--Japan caught the brunt of the storm tracks this month. The vast majority of the cyclones that originated in the western Pacific affected that nation. An abnormal high-pressure center over the Sea of Okhotsk diverted the cyclones off the continent southward. These storms, plus those that formed farther south, had a more easterly component over the western ocean, and then a more northerly component over the central ocean, than the climatic mean. More storms tracked into the eastern Bering Sea, and fewer into the Gulf of Alaska, than normal. Higher-than-normal pressure over extreme northern Canada diverted the storms away from the Gulf of Alaska and farther south along the U. S. west coast.

The mean pressure of the Aleutian Low was normal --1005 mb --but was located about 20° longitude east of its mean position. The 1017-mb high-pressure center located west of Ostrov Paramushir radically changed the orientation of the isobars in that area. The Pacific High at 1025 mb was centered near its mean position, but 3 mb higher in pressure. As previously mentioned, a 1029-mb High was centered over Banks Island, on the edge of the Beaufort Sea.

The major anomalies were positive. A plus 11-mb center was near the southern tip of the Kamchatka Peninsula, and a plus 8-mb center was over Victoria Island. A large, shallow anomaly bounded by the minus 2-mb isoline stretched eastward from south of Shikoku to about 165°E. Another large, shallow, positive anomaly area covered most of the central eastern Pacific.

As with the surface, the upper-air Low was east of its mean position and, in this case, also north, over the Anadyrskiy Gulf rather than the Sea of Okhotsk. The height of the Low center was slightly lower than the climatic mean, and the High was higher than the mean.

Extratropical Cyclones--This was an offshoot of a LOW that developed near Japan, the last of February. A double LOW center developed, on the 1st, and the new 989-mb center became the primary storm. The POLAR ALASKA measured 44-kn winds at 47°N, 157.2°E, at 1800. By 1200 on the 2d, the 972-mb center was near Attu Island, with its circulation extending as far south as 30°N. Gales were blowing in all quadrants. On the 3d, the VOLNA (48°N, 175°E) reported 45-kn winds, and the TRANSOCEAN TRANSPORT (49.8°N, 169.2°E) measured 47-kn winds, and both were fighting 33-ft waves. There were several other reports of 20- to 25-ft seas in the area 300 to 600 mi south of the LOW. On the 4th, the AMERICAN MAIL, at 45°N, 174.5°E, had 70-kn southerly typhoon-force winds, but only reported 13-ft seas. The visibility was down to 2 mi, but the "present weather" code was missing. At this time, the center had moved inland near Mys Navarin, and over cold land it quickly decayed.

This circulation started in a col on an old washed-out front, on the 1st. It moved rapidly southeastward around an upper-air LOW centered near 45°N, 135°W. Gale-force winds were blowing in the western quarter. On the 3d, the TRANSONEIDA, near 37.5°N, 144°W, reported 40-kn northerly winds. The KASHU MARU, about 200 mi to the south, reported 26-ft swells.

At 0000 on the 4th, the central pressure of the LOW was only 1006 mb, near 37°N, 134°W, but the AUSTIN found 55-kn winds near 33.5°N, 142.5°W, and 18-ft waves. The LOW drifted toward the coast, maintaining a pressure slightly over 1000 mb. On the 5th, another LOW formed near 41°N, 144°W, and also traveled southeastward, picking up the circulation of the other LOW. The winds were generally minimal gale force. As it approached the coast, on the 7th, it turned northward and, by 1200, was 991 mb near 38°N, 128°W. The CHEVRON HAWAII was off Point Buchon, with 45-kn winds and 16-ft seas. Storm warnings were flying along the California coast, where southerly winds gusted to 60 kn. By the 9th, the LOW was decaying over Vancouver Island, and the winds along the coast had shifted to northwesterly.

The history of this storm starts over eastern Mongolia on the 1st. It moved across the Sea of Japan on the 2d. By the 4th, it was 1002 mb near 37°N, 158°E. The PRIBOY was near 34°N, 160°E, sailing into 40-kn gales and 18-ft seas. The LOW was moving rapidly northeastward under the influence of the westerlies, prior to curving northerly on the 5th. At 0000, the 985-mb LOW was near 47°N, 172°E. Approximately 100 mi to the southeast, the AMERICAN MAIL was being hammered by 60-kn starboard winds driving 21-ft seas. A ship east of the center reported 50-kn southerly winds.

As the center moved over the Near Islands, small LOWs were forming on the periphery of the circulation. These effectively weakened the circulation, decreasing the windspeeds. The major center still managed to bring 40-kn gales to the western Aleutians, and far to the southeast, ahead of the front, ships reported southerly winds to 45 kn and waves up to 26 ft. The storm moved into the Olyutorskiy Gulf, where it disappeared.

This was one of the LOWs that formed south of the previous storm. At 0000 on the 6th, it had already formed a deep pocket in the circulation. There was only one ship report near the storm at 1200, but at 1800, the PLUTOS found 45-kn gales near 38.9°N, 176.3°W, and at 0000 on the 7th, there were many reports. The storm was centered near 44°N, 170°W, at that time. The KANETOSHI MARU (38.5°N, 170°W) had 50-kn winds on her stern as she sailed eastward. Southwest of the center, at 42.5°N, 175.5°W, the ASIA BOTAN was reporting only 40-kn northwesterly winds, but the seas were reported as 46 ft.

The storm track was curving northwestward, later on the 7th, and gales were occurring over the Bering Sea. On the 8th, the DAIAN MARU was within the 50-kn isotack analysis. The ASIA BOTAN was now re-

porting 33-ft swells at 44°N, 169°W. As the LOW crossed the Aleutian Islands, it was absorbed by a stronger circulation.

This LOW moved off the China coast and over the East China Sea, late on the 4th. It already had a well-developed circulation, and moved south of Japan on the 5th and 6th. At 0600 on the 5th, the AMERICAN AQUARIUS found 45-kn gales just south of Kyushu. On the 6th, the CHRISTIAN MAERSK (34.7°N, 149.3°E) fought 48-kn winds.

At 0000 on the 7th, the 978-mb LOW was near 39°N, 156°E, and, at 0600, the BELHUDSON, at 39.2°N, 167°E, measured 65-kn typhoon-force winds. At 0600 on the 8th, the HONSHU MARU, at 48.6°N, 170.9°E, measured 45-kn gales, with 20-ft seas and 30-ft swells.

Early on the 9th, the 962-mb LOW crossed the Aleutian Islands, near Amchitka Island, into the Bering Sea. It was still churning up gale-force winds, and waves up to 23 ft. On the 11th, the storm turned northwestward and got lost over Siberia on the 12th.

Although this cyclone had its origin, late on the 9th, over the Korea Strait, it was not until the 14th, near Bristol Bay, that it earned a reputation. It moved eastward and then northeastward very rapidly, averaging over 40 kn for the first 48 hr. It created several instances of Beaufort force 7 and 8 winds along its path, and 15- to 20-ft seas. On the 12th, its center moved into the Bering Sea, and late on the 13th, stalled near Bristol Bay. At 0000 on the 14th, the NORBU reported 28-ft seas and 46-ft swells just north of Unmak Island. About 60 mi south of the Islands of the Four Mountains, the MIDAS ARROW fought 45-kn winds, 28-ft seas, and 46-ft swells. Several other ships reported over 20-ft waves. Within a matter of hours, the LOW had disappeared, as the circulation of a LOW in the Gulf of Alaska destroyed it.

This seemingly insignificant LOW was analyzed at the triple-point of a frontal occlusion on the 0000 chart of the 20th. The front was associated with a LOW that formed south of Japan on the 15th. By 1200 on the 20th, this had become the major circulation, with the pressure falling 8.4 mb at Ocean Station Vessel "P" in the previous 3 hr. The storm's central pressure was 979 mb, at 50.5°N, 147°W. At 0000 on the 21st, high winds were blowing over the Gulf of Alaska and as far south as 35°N. The ASIA MONO had the worst of it, though, as she was buffeted by air moving at 80 kn. She was only reporting waves as high as 20 ft, but with that much wind, it was probably difficult to tell, because of spray, where the sea stopped and the atmosphere began. The EASTERN BUILDER reported 60-kn winds and 38-ft swells near 45°N, 146°W.

At 1200, Ocean Station Vessel "P" was tossed by 55-kn winds. No seas were plotted. At 0900, the winds were 60 kn, and no seas. Three hundred miles to the south, where the SEA-LAND TRADE reported only 40-kn winds, the waves were 25 ft. The ASIA BRIGHTNESS, at 45.1°N, 141.9°W, had 50-kn winds, at 1300, and shattering 26-ft seas, with 46-ft swells. The high winds and waves followed her into the 22d.

The 0000 chart of the 22d indicated the PRIAM with 50-kn winds, 26-ft seas, and 38-ft swells, near 45°N, 134°W. The KATANGLI, near 48°N, 139°W, was battered by 33-ft seas and swells. Luckily, they were from the same direction, but the periods differed. Storm warnings along the Oregon and Washington coasts called for 55-kn winds, and 10- to 20-ft waves were lashing the shore. The storm went ashore late on the 22d.

This LOW formed in midocean, late on the 24th, in an area of weak gradient north of a LOW moving eastward near latitude 37°N. The new system moved northeastward and, at 1200 on the 25th, was 982 mb near 45°N, 167°W. On the 26th, the SEA-LAND GALLOWAY, at 47°N, 172°W, was blown by 50-kn northerly winds on her port side. The seas were 18 ft. A ship just north of the center was pounded by 26-ft swells. On the 27th, the 970-mb LOW was centered over Bristol Bay. The ASIA BOTAN measured 48-kn winds, at 54.6°N, 169.9°W, with 26-ft seas and 39-ft swells. On the 28th and 29th, the LOW circled south of St. Lawrence Island as it dissipated.

This storm came out of Mongolia, closely following the track of another storm the first of the month until it reached the Kuroshio Current on the 30th. At 1200, the 982-mb center was near 39°N, 149°E. There were gales both north and south of the center. The VAN HORNE, at 35.7°N, 153.5°E, had 45-kn westerlies, with 16-ft seas, and 30-ft swells from the southwest, on the 31st. The ASIA BOTAN, near the central Kuril Islands, was battered by 55-kn winds. The storm was now tracking northward. Gales were the order of the day south of the center, from the Japanese coast to 165°E. The main concern, though, was high seas, the highest being 30 ft by the VAN HORNE, near 38°N, 157°E.

On the 1200 chart, the KINYO MARU was heading into 50-kn winds and 26-ft swells, about 250 mi south-southeast of the center. Others reported 15 to over 20 ft. At 0600 on the 31st, the EASTERN BUILDER measured 55-kn winds at 38.3°N, 153.5°E, where the swells were 33 ft. The winds had decreased for the ASIA BOTAN, which was sailing southwestward, but she now had 26-ft swells. At 0600 April Fools Day, the EASTERN BUILDER was about 400 mi south of the center, on a southwesterly course, with 51-kn winds, 8-ft seas, and 33-ft swells.

The storm was slowly tracking northeastward, east of the Kuril Islands. On April 2, another center developed north of the original one, near the Near Islands. On the 3d, the northern LOW became the major circulation center, with a sharp trough to the south. A ship near the edge of the ice field reported 40-kn winds. At 0000 on the 4th, the Siberian station of Anadyr measured 60-kn easterly winds. Later that day, the center moved over the cold land and disintegrated.

A front was the instigator of this storm. The 1010-mb wave formed, on the 29th, and raced northeastward, changing little in pressure or character. As it approached the Alaska Peninsula, it deepened rapidly and was 994 mb, near 56°N, 154°W, at 0000 on April 1. The JOHAN U and OCTA, in the Gulf of Alaska, reported gale-force winds, with 23-ft seas. Ocean Weather Station "P" had 40-kn gales.

On the 2d, the LOW had a central pressure of 987

mb, near 56°N, 139°W. The SHOGEN MARU, near 52.5°N, 145°W, was sailing into 50-kn winds, 13-ft seas, and 21-ft swells. OWS PAPA was measuring 25-ft seas. Four ships reported strong gales and/or high waves, at 0600. The SANTA MARIA (52.9°N, 140.2°W) had only 8-ft seas, but the swells were 33 ft. Ocean Buoy EB-03 reported 21-ft seas.

The LOW started to fill and weaken, on the 3d, but there were several gale reports early in the day, and PAPA was still rolling in 25-ft seas. On the 4th, the storm moved onshore.

Casualties--The Japanese motorvessel TRANSPACIFIC TRADER, Astoria for Japan, diverted to Honolulu, on the 4th, due to shifting of logs on deck, probably because of rough weather.

SMOOTH LOG, APRIL 1975--The storms this month, in general, were not as severe or intense as usual, although they were above normal in number. The primary tracks were displaced somewhat, especially over the west central ocean. The primary tracks from off the Asian continent and from south of Japan had a more easterly, than the climatic northeasterly, direction. Near longitude 165°E, the tracks turned north-northeastward and northeastward--the northern ones into the western half of the Bering Sea, and the southern ones to parallel the Aleutian Islands and into Alaska and the Gulf of Alaska. The broad expanse of ocean between Hawaii and the U. S. coast was almost devoid of cyclone centers.

The mean sea-level pressure analysis reflected the storm tracks. The large ocean area approximately bounded by the Bering Strait, North American west coast, 20°N, and 160°E, was above normal in pressure. The western ocean west of 160°E was near normal, or slightly below normal. There were three low centers across the northern ocean, all 1010 mb, versus the 1009-mb climatic value. The Pacific High, normally about 1023 mb, was 1030 mb and centered farther east, near 35°N, 145°W.

The most significant anomaly was a positive 11-mb centered near 45°N, 145°W. A less significant anomaly was a positive 3-mb over Sakhalin Island. Although not large, it was definitely reflected in the storm tracks out of Asia.

The upper-air pattern resembled climatology, only shifted. The primary low center was over the Sea of Okhotsk, rather than the central Bering Sea, but the trough was shifted eastward off the coast of Japan, rather than along the continental coast. There was a stronger ridge than normal off the U. S. west coast, and it was closer to the coast by about 10° of longitude.

There were no tropical storms this month.

Extratropical Cyclones--The first storm of the month formed over the Chinese mainland, on the 4th, and raced across the Yellow Sea and the Sea of Japan, and into the Sea of Okhotsk on the 6th.

This storm wreaked havoc over Japan. Battering winds of 40 kn swept through the archipelago on the 5th and 6th. Five vessels were capsized in rough seas, killing four persons; another four were missing. Two more persons were killed as the result of strong winds. Two freighters ran aground near Kobe Port because of high winds. They were the 9,249-ton ATLANTIC NEPTUNE and the 1,595-ton MINILILAC. Another freighter, the 8,397-ton ADELINA, was pushed aground near Onahama Port. Helicopters took off all 39 crewmen because the vessel was flooded to a dangerous level. The TAIKO MARU capsized off Wakayama Prefecture, with only two of seven crewmen rescued. In the same area, the 7,894-ton ORIENT STAR went aground.

At 1800 on the 5th, the JAPAN BEAR measured 44-kn winds and 15-ft seas, near 33.7°N, 136.9°E, and, as she sailed eastward, 53-kn winds and 13-ft seas, at 0600 on the 6th, near 34.5°N, 139.2°E. A coastal station on the Tatar Strait had a 40-kn norther. The PRESIDENT TAFT fought 45-kn winds and 23-ft seas at 35.5°N, 146.5°E, and the CRESSIDA (43.2°N, 154°E) measured 57-kn winds at 43.2°N, 154°E. At 1200, the 980-mb storm was centered over the Kuril Basin, and another coastal station, on the west coast of Kamchatka, was warmed by 40-kn southerly winds. On the 7th, a ship which may have been the BIZON fought 45-kn winds and 23-ft seas on the Sea of Okhotsk.

As the storm center moved northward over the cold water and ice, it started to fill, and no longer existed on the 8th.

An almost stationary cold front had been pushing against a stubborn HIGH, located between Hawaii and Alaska, for several days. Frontal waves had been developing on the front, but none gained notoriety. On the 5th, another developed near 30°N, 178°E. It moved northeastward between two 1032-mb HIGHs. On the 5th and 6th, no gale-force winds were reported, but, by 0000 on the 7th, the 990-mb storm was near 42°N, 171°W, and one of the highest winds of the month was observed. A SHIP, near 38°N, 174°W, was battered by 60-kn northerly winds driving 33-ft seas and swells. The VOSGES, northwest of the center at 42.5°N, 174°W, had 45-kn portside winds. Many ships, 300 to 400 mi south of the center, had gales with 15- to 20-ft waves. Early on the 8th, the SANTA CATALINA MARU was in the northwest quadrant with 50-kn winds and 20-ft swells. The VOSGES was now fighting 25-ft seas. On the 9th, the highest winds radioed to METEO were 35 kn, but there were several reports of 26-ft swells, and more of 20 ft. On the 11th, the LOW was in the Gulf of Alaska, but it had lost its punch battling the high pressure.

This was one of the longer-lived storms of the month. It originated on the 8th over Mongolia, and dissipated over Alaska on the 16th. On the 10th, it moved over the Sea of Japan, not yet a severe storm.

The first gales were reported on the 12th, when the 988-mb LOW was near 44°N, 152°E. Early on the 12th, the HOTAKA MARU was off the Kuril Islands, with 45-kn northwesterlies. There were 35-kn gales up to 600 mi south and southeast of the center. On the 12th and 13th, the AKAISHI MARU, CURACO MARU, and WAKANESAN MARU all reported gales. About 0100 on the 13th, the 976-mb center passed directly over the Near Islands. At 1200, the OHMINESAN MARU, north of Unimak Island, had chilling 45-kn southerly winds, with 13-ft seas and 16-ft swells.

Late on the 14th, the LOW moved over the Bering Sea ice field and began to fill rapidly. It was still a small circulation as it moved into western Alaska and

disappeared on the 16th.

This low center more or less just came into being over the Gulf of Alaska. It had no real track, as it remained quasi-stationary over the northern Gulf. On the 16th and 17th, there were several minor troughs and LOWs in the area, and two small LOWs moved in from the southwest. These all gradually combined into a double-centered LOW, on the 17th. On the 18th, the PHILADELPHIA, at 57°N, 144°W, found 35-kn gales and 16-ft swells. The ALASKA MARU was sailing into 45-kn gales and 20-ft swells, near 52°N, 148°W, on the 19th. The PHILADELPHIA was now fighting into 45-kn gales, with 15-ft seas and 30-ft swells. The ESSO NEWARK was headed into the Gulf, near 51°N, 138°W, with 35-kn port winds. By the 20th, the center was little more than a weak area in the isobars off Juneau.

At midday on the 20th, there were eight cyclonic circulations of various strengths analyzed on the chart between 170°E and the Asian mainland. One of these centers, near 41°N, 163°E, was destined to produce high waves. As usual, the LOW tracked northeastward and, at 0000 on the 22d, was near 51°N, 178°E, at 998 mb. East of the center, at 49°N, 175°W, the GYOKUYO MARU was steaming into 35-kn gales from the southeast. The seas were running at 31 ft, with interspersed 16-ft swells. Twenty-four hours later, the 990-mb LOW was south of the Alaska Peninsula. The VINGNES, south of Amlia Island, found 40-kn gales. About 300 mi south of the center, the TOWER BRIDGE was headed into 35-kn westerlies, 20-ft seas, and 25-ft swells.

The storm continued eastward across the Gulf of Alaska and passed inland over Vancouver Island, late on the 24th.

The East China Sea was the whelping ground of this LOW, on the 19th. It moved along the southern coast of Japan on the 20th and 21st. At 0000 on the 22d, the 1000-mb LOW was at 35°N, 150°E, with the tightest gradient on the eastern side of the circulation. Even so, the MAREN MAERSK found 50-kn winds and 23-ft seas on the western side, near 34.7°N, 143.7°E. The TOYOTA MARU was in the warm sector, southeast of the center. She observed only 30-kn winds with 10-ft seas, but the swells were 23 ft.

The LOW turned northeastward and slowly intensified in pressure, but it was not until the 24th that the circulation expanded. Early on the 24th, the BAY BRIDGE encountered 40-kn winds in the southwest quadrant. At 0600, the center crossed into the Bering Sea. At 1200, the SUMMIT was at 54.3°N, 165.8°W, with 60-kn winds blowing heavy snow which reduced the visibility to a half mile. Not far away in relative distances, at 52.7°N, 171.9°W, the MIDAS ARROW measured 42-kn winds, 17-ft seas, 25-ft swells, and rain showers, at 1800. At 0000 on the 25th, the 962-mb LOW was at 57°N, 167°W, and the HAKUZAN MARU was at 53°N, 164°W, south of the islands, sailing eastward with 55-kn winds and 31-ft swells. Twelve hours later, the OHMINESAN MARU (at 56°N, 166°W) was chilled by 45-kn northwesterlies blowing moderate snow. The dry-bulb temperature was -1°C. The ALASKA STANDARD had 45-kn winds from the southeast in Cook Inlet.

At 0000 on the 26th, the PACPRINCESS, at 53°N, 156°W, was battering into 33-ft swells and 40-kn westerly winds. The LOW had moved inland over Cape Newenham, and the rugged terrain was tearing it apart.

Casualties--The British tanker ARDSHIEL (119,678 tons) broke her moorings in heavy weather at Singapore, on the 2d, and drifted aground with some damage. Two ships collided in dense fog off Onahama Port, on the 15th. They were the 999-ton OTE MARU and the 15.053-ton KING JU. Fog was again the culprit, on the 27th, when the STAR BILLABONG and the YAMATO MARU collided in Tokyo Bay.

High winds and waves can be jarring, but collisions in fog are more so. On the 29th, the fog was over Osaka Bay, where the 4,694-ton ferry KATSURA and the 3,967-ton container ship SANSHIN STAR collided. Only 10 of the 409 passengers on the ferry suffered injuries. No crewmen on either ship were hurt. The next day, on the 30th, the 378-ton Japanese freighter SHORYU MARU and the 9,084-ton KOSTANITIS YEMELOS tried to occupy the same space on Tokyo Bay, while fogged in.

An unexplained 25-ft wave roared down Douglas Channel, in British Columbia, and caused extensive damage at the village of Kitimat. A similar wave occurred last fall.

THE MARINERS WEATHER LOG WELCOMES ARTICLES AND LETTERS FROM MARINERS RELATING TO METEOROLOGY AND OCEANOGRAPHY, INCLUDING THEIR EFFECTS ON SHIP OPERATIONS.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

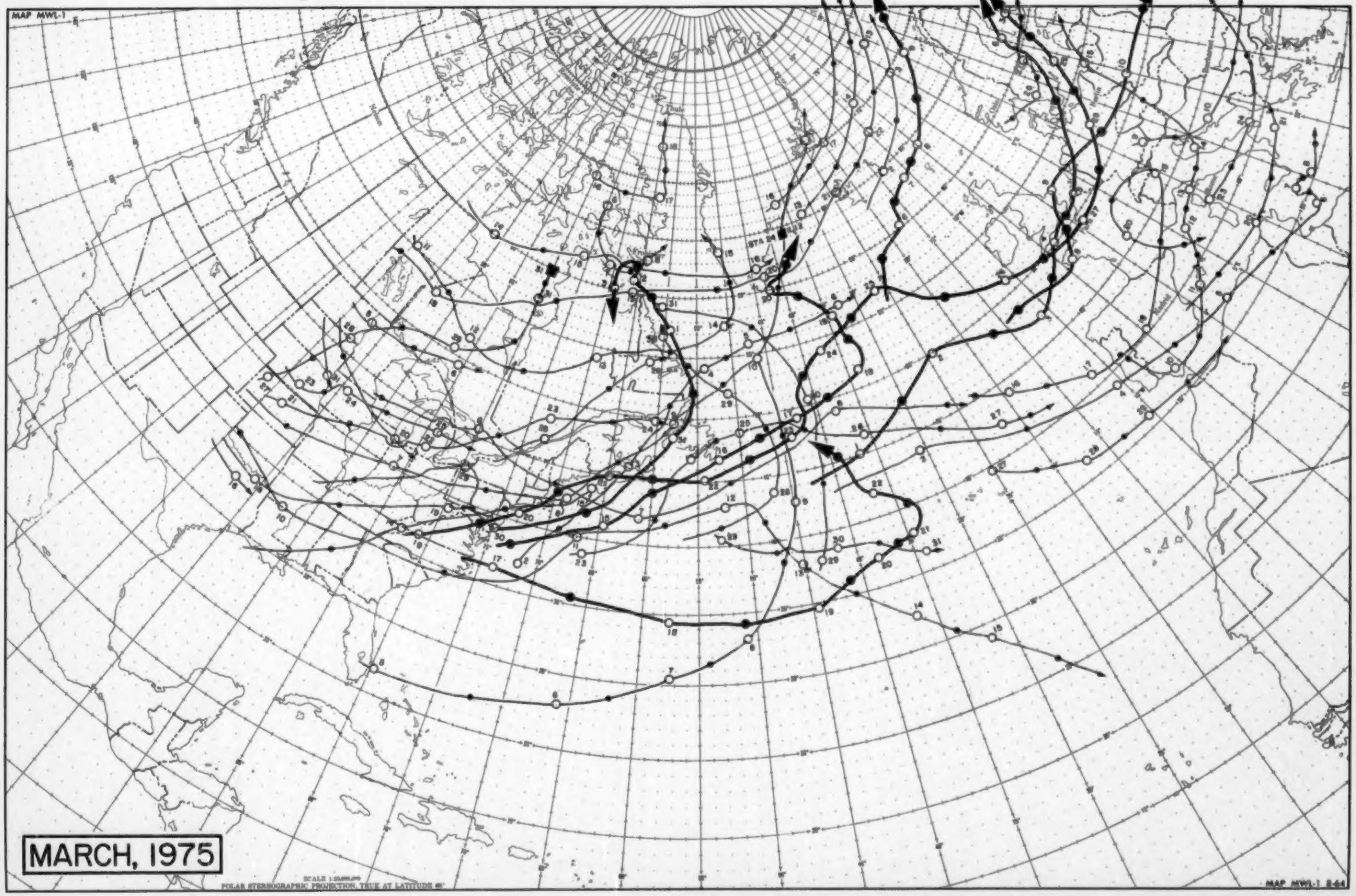

Figure 35.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

Figure 35.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

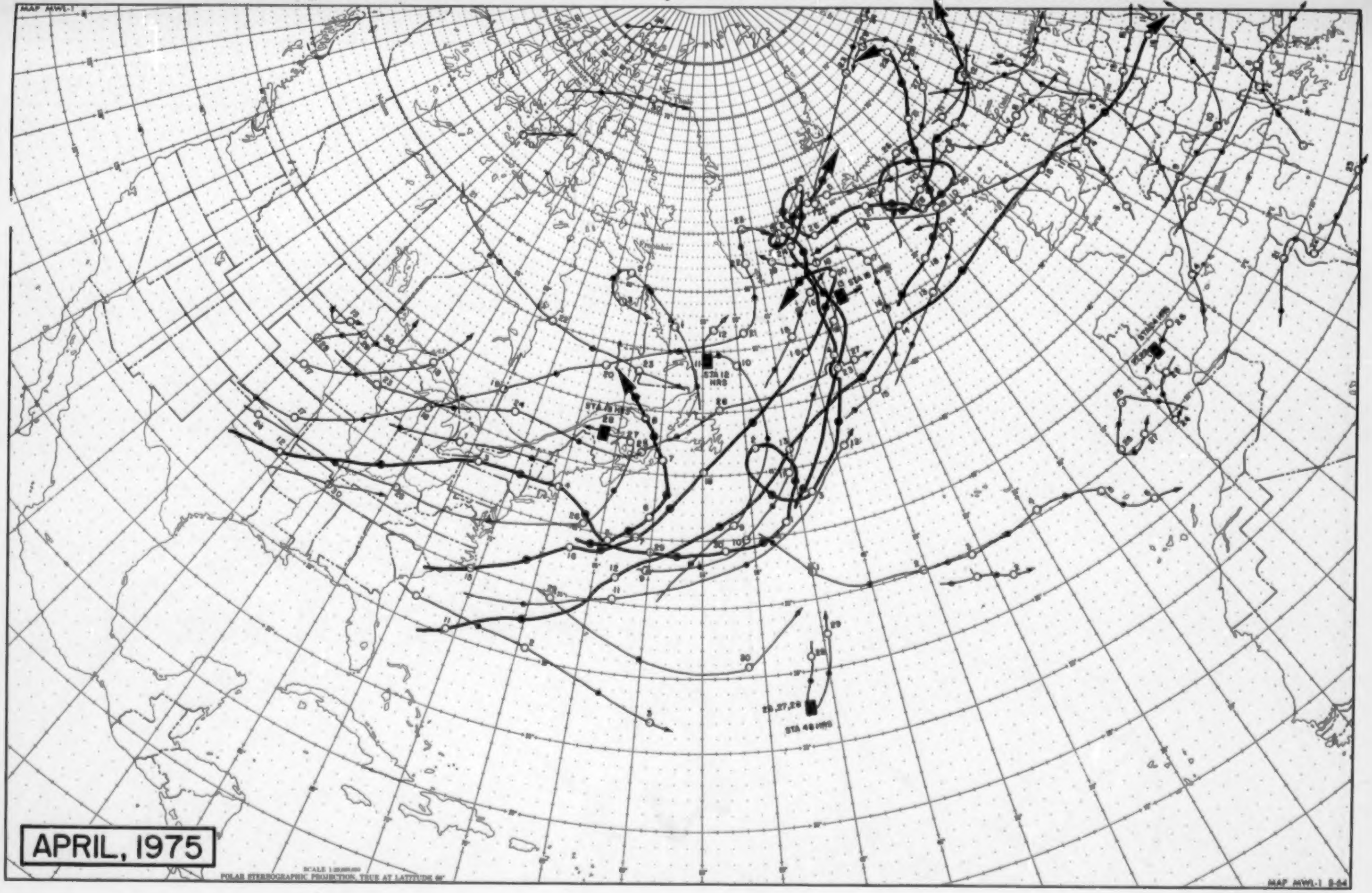

Figure 36.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

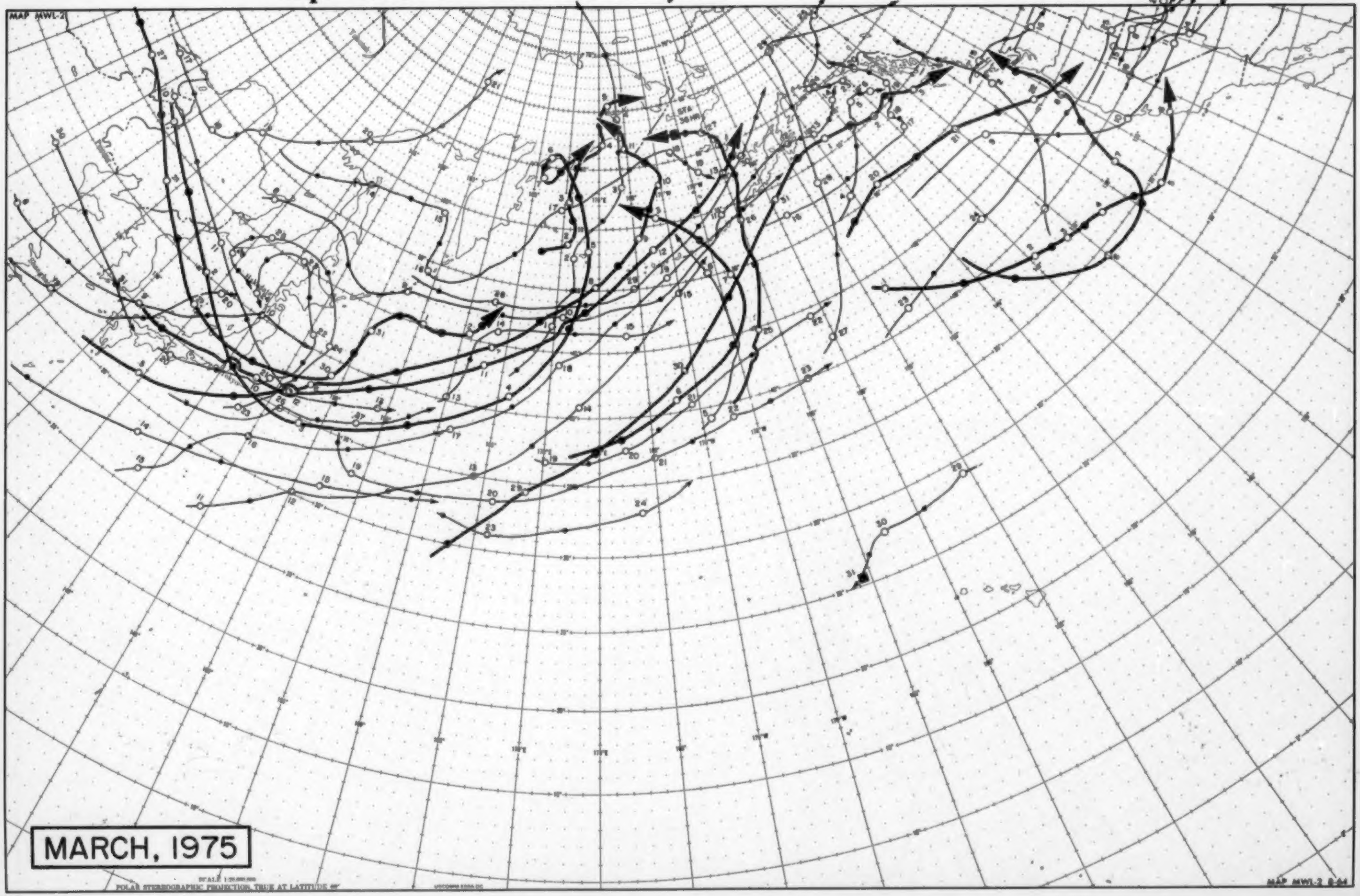

Figure 37.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Figure 37.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

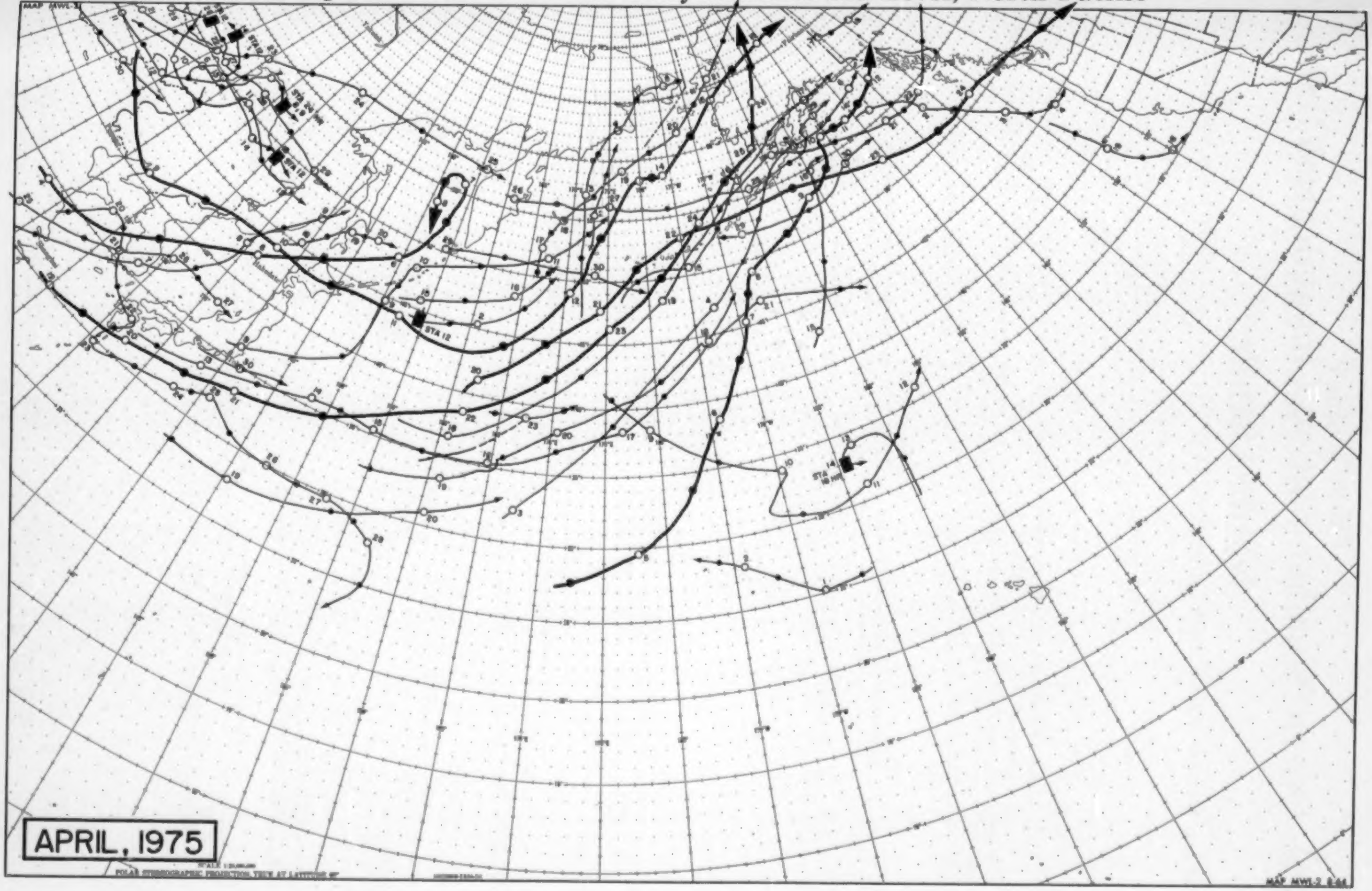

Figure 38.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 5
U.S. Ocean Weather Station Climatological Data, North Atlantic

Ocean Weather Station 'HOTEL' 38°00'N 71°00'W — **March and April, 1975**

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
MAR	.6	09 15	10.5	22.7	28 09	-3.2	09 15	9.3	19.3	14 21	11.8	27 12	18.9	21.7	*25 15	-14.1	31 21	-3.6	6.0	13 16
APR	DATA NOT AVAILABLE																			

MONTH	MEANS AND EXTREMES: PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS): TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	DAYS WITH SPECIFIED WEATHER: PCPN	RAIN OR DRZL	SNOW	TSTM	VERY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	HOURS WITH PCPN	NO OF OBS
MAR	983.0	02 15	1013.9	1031.0	16 15	13.3	14.5	24.6	47.6	35.1	27.0	20.6	17.3	24	23	5	2	1	10	9	1	31	16.9	248
APR	DATA NOT AVAILABLE																							

** VV-90-93 AND/OR W=4 — COMP OB DAYS=COMPLETE OB DAYS

Wind

MAR — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

WIND SPEED (KNOTS)

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.4	1.0	1.9	2.3	.0	.4	8.8	19.6
NE	.4	.8	1.9	1.7	2.1	.0	7.0	23.1
E	.4	1.6	3.4	1.2	.7	.2	7.6	18.5
SE	.0	1.3	.4	1.7	.2	.2	4.0	19.2
S	.0	1.4	3.0	3.0	1.3	1.0	9.8	24.5
SW	.0	1.7	4.5	4.2	1.3	.0	11.6	19.9
W	.3	2.3	5.7	4.9	2.4	.0	15.7	20.9
NW	.9	3.1	9.1	15.1	11.3	.8	38.3	27.2
CALM	.4	.0	.0	.0	.0	.0	.4	.0
TOTAL	2.8	13.3	27.8	34.3	19.6	2.4	100.0	23.4

NUMBER OF OBS 248 — MAX WIND: DIR 160, SPEED 65, DA HR 20 0255 — VECTOR SPEED 10.8 — MEAN DIR 301 — (DIR IN DEGREES)

APR — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

WIND SPEED (KNOTS)

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N								
NE								
E								
SE								
S	DATA NOT AVAILABLE							
SW								
W								
NW								
CALM								
TOTAL								

NUMBER OF OBS — MAX WIND: DIR, SPEED, DA HR — VECTOR SPEED — MEAN DIR — (DIR IN DEGREES)

Wave

MAR — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

WAVE HEIGHT (METERS)

DIR	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	.8	.7	1.2	.7	.0	.0	.0	3.4
NE	.0	.9	2.7	1.6	1.6	1.2	.0	.0	7.9
E	.0	.3	1.3	1.0	1.6	.0	.0	.0	4.2
SE	.1	.0	1.2	.1	.1	.0	.3	.0	1.8
S	.3	1.7	2.0	2.9	1.8	.8	2.1	.0	11.7
SW	.0	3.2	2.9	3.5	1.7	.4	.0	.0	13.8
W	.0	3.9	2.2	1.7	2.7	.0	.0	.0	10.6
NW	.0	4.4	7.1	5.4	18.8	2.4	.0	.0	38.1
IND	.8	4.4	3.2	.0	.0	.0	.0	.0	8.5
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	1.2	21.8	23.4	17.3	29.0	4.8	2.4	.0	100.0

NUMBER OF OBS 248 — IND=INDETERMINATE

APR — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

WAVE HEIGHT (METERS)

DIR	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N									
NE									
E									
SE									
S	DATA NOT AVAILABLE								
SW									
W									
NW									
IND									
CALM									
TOTAL									

NUMBER OF OBS — IND=INDETERMINATE

MAR — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

WAVE HEIGHT (METERS)

PERIOD IN SECONDS	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.0	8.9	2.4	.4	.0	.0	.0	.0	11.7
6-7	.0	7.3	11.7	11.3	8.5	.4	.0	.0	39.1
8-9	.4	1.2	4.8	4.4	17.7	.4	.0	.0	29.0
10-11	.0	.0	1.2	1.2	2.4	3.2	.0	.0	8.1
12-13	.0	.0	.0	.0	.0	.0	2.0	.0	2.0
>13	.0	.0	.0	.0	.4	.8	.4	.0	1.6
IND	.8	4.4	3.2	.0	.0	.0	.0	.0	8.5
TOTAL	1.2	21.8	23.4	17.3	29.0	4.8	2.4	.0	100.0

NUMBER OF OBS 248 — MAX WAVE HEIGHT: HGT 8.0, PER 12, DIR 180, TYPE SEA, DA HR 19 21 — IND=INDETERMINATE — (DIR IN DEGREES)

APR — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

WAVE HEIGHT (METERS)

PERIOD IN SECONDS	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6									
6-7									
8-9									
10-11	DATA NOT AVAILABLE								
12-13									
>13									
IND									
TOTAL									

NUMBER OF OBS — MAX WAVE HEIGHT: HGT, PER, DIR, TYPE, DA HR — IND=INDETERMINATE — (DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 6
U.S. Ocean Buoy Climatological Data,
March and April 1975

MARCH — DATA SUMMARY — EB01
AVERAGE LATITUDE 36.5N — AVERAGE LONGITUDE 073.9W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	01.5	(09 12)	12.2	22.5	(14 21)	267	31
DEWPOINT TEMP (DEG C)	-04.6	(04 06)	07.1	20.9	(14 21)	239	31
SEA TEMP (DEG C)	11.1	(27 03)	18.7	24.5	(02 03)	266	31
AIR-SEA TEMP (DEG C)	-20.5	(03 00)	-06.5	07.6	(30 15)	266	31
PRESSURE (MBAR)	0991.9	(02 12)	1015.1	1031.3	(16 15)	267	31

MARCH — DATA SUMMARY — EB03
AVERAGE LATITUDE 56.0N — AVERAGE LONGITUDE 147.9W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-07.0	(22 15)	01.2	03.9	(07 21)	245	31
DEWPOINT TEMP (DEG C)	-09.3	(23 12)	-01.5	03.4	(28 12)	239	31
PRESSURE (MBAR)	0984.5	(14 15)	1008.2	1027.1	(30 03)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 248

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	7.7	5.6				13.7	10.2
NE	1.2	3.2	2.4				6.9	7.9
E	.4	6.5	2.0	.8			9.7	10.2
SE	1.2	1.2	3.6	1.2			7.3	13.4
S	1.2	4.0	4.4				9.7	9.9
SW	1.6	11.3	3.6				16.5	8.0
W	.8	8.9	14.9	.4	.4		25.4	12.0
NW	.4	4.0	4.4	.4			9.3	10.8
CALM	1.6						1.6	.0
TOTAL	8.9	46.8	41.1	2.8	.4		100.0	10.2

MAX WIND
SPEED: 34 KNOTS
DIRECTION: 270 DEG
DAY: 14
HOUR: 06

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 246

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY		14.6	26.0	43.9	14.2	1.2			2.9M	6.3M	(14 09)

PRECIPITATION
NO. OF DAYS WITH PRECIP: 7 NO. OF DAYS WITH REPORTS/ COMPLETE: 31 PARTIAL: 0
NO. OF OBS WITH PAST OR PRESENT PRECIP: 15 NO. OF WEATHER OBS: 248

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 4.5% SEVERE: NONE #OBS: 248

APRIL — DATA SUMMARY — EB03
AVERAGE LATITUDE 56.0N — AVERAGE LONGITUDE 147.9W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-02.4	(02 12)	02.4	04.3	(17 00)	240	30
DEWPOINT TEMP (DEG C)	-07.9	(02 12)	00.3	04.3	(17 00)	238	30
PRESSURE (MBAR)	0990.9	(01 12)	1010.9	1040.7	(14 00)	240	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 238

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.3	4.6	2.9				8.8	8.3
NE	1.3	.4	.4				2.1	9.0
E	.4	.4	1.3	.4			2.5	14.2
SE	1.3	1.7	8.0				10.9	11.8
S	1.3	13.4	8.8				23.5	9.6
SW	.8	10.1	3.8				14.7	8.4
W	4.2	11.3	4.6				20.2	7.4
NW	1.7	5.5	7.1	2.9			17.2	13.0
CALM								
TOTAL	12.2	47.5	37.0	3.4			100.0	9.7

MAX WIND
SPEED: 31 KNOTS
DIRECTION: 330 DEG
DAY: 02
HOUR: 09

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 240

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY		22.5	47.1	12.1	10.4	6.3	1.7		2.7M	8.3M	(02 03)

PRECIPITATION
NO. OF DAYS WITH PRECIP: 8 NO. OF DAYS WITH REPORTS/ COMPLETE: 30 PARTIAL: 0
NO. OF OBS WITH PAST OR PRESENT PRECIP: 10 NO. OF WEATHER OBS: 240

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 1.3% SEVERE: NONE #OBS: 238

MARCH — DATA SUMMARY — EB12
AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 094.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	21.1	(02 12)	23.1	26.5	(04 18)	56	7
DEWPOINT TEMP (DEG C)	16.6	(05 15)	19.5	23.2	(07 21)	56	7
PRESSURE (MBAR)	1013.0	(03 21)	1016.7	1019.4	(07 15)	56	7

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 55

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		1.8	5.5				7.3	13.8
NE		3.6	7.3				10.9	13.5
E		1.8	18.2				20.0	13.7
SE	3.6	9.1	23.6				36.4	12.1
S	1.8	1.8	5.5				9.1	14.0
SW	1.8	3.6					5.5	4.3
W	5.5	5.5					10.9	3.7
NW								
CALM								
TOTAL	12.7	27.3	60.0				100.0	11.5

MAX WIND
SPEED: 20 KNOTS
DIRECTION: 170 DEG
DAY: 07
HOUR: 12

PRECIPITATION
NO. OF DAYS WITH PRECIP: 2 NO. OF DAYS WITH REPORTS/ COMPLETE: 7 PARTIAL: 0
NO. OF OBS WITH PAST OR PRESENT PRECIP: 2 NO. OF WEATHER OBS: 56

MARCH — DATA SUMMARY — EB13
AVERAGE LATITUDE 32.3N — AVERAGE LONGITUDE 075.2W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.9	(03 15)	18.5	25.5	(23 18)	190	24
DEWPOINT TEMP (DEG C)	00.8	(03 12)	13.2	23.0	(15 03)	190	24
PRESSURE (MBAR)	0997.6	(02 09)	1016.3	1027.4	(16 03)	190	24

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 187

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.5	1.1	3.7	.5			5.9	13.7
NE		1.1	2.7	.5			4.3	14.3
E	.5	5.2	7.0	2.7			15.4	14.7
SE		.5	.5	1.6	1.1		3.7	24.9
S		2.7	10.2	11.8	.5		25.1	20.0
SW		1.1	7.0	4.3	1.1		13.4	20.6
W		1.1	8.0	11.8	2.7		23.5	24.4
NW	1.1	1.1	4.3	4.3			10.7	18.1
CALM								
TOTAL	2.1	11.8	43.3	37.4	5.3		100.0	19.8

MAX WIND
SPEED: 39 KNOTS
DIRECTION: 230 DEG
DAY: 28
HOUR: 03

PRECIPITATION
NO. OF DAYS WITH PRECIP: 10 NO. OF DAYS WITH REPORTS/ COMPLETE: 23 PARTIAL: 1
NO. OF OBS WITH PAST OR PRESENT PRECIP: 22 NO. OF WEATHER OBS: 190

APRIL — DATA SUMMARY — EB13
AVERAGE LATITUDE 32.3N — AVERAGE LONGITUDE 075.2W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	13.5	(04 09)	19.6	23.7	(03 15)	11	2
DEWPOINT TEMP (DEG C)	06.3	(04 09)	15.7	25.1	(03 15)	11	2
PRESSURE (MBAR)	1001.4	(03 18)	1005.3	1010.1	(03 03)	11	2

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 11

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N								
NE								
E								
SE								
S								
SW		9.1	18.2	9.1	9.1		45.5	20.2
W				18.2	9.1		27.3	32.0
NW				27.3			27.3	29.0
CALM								
TOTAL		9.1	18.2	54.5	18.2		100.0	25.8

MAX WIND
SPEED: 34 KNOTS
DIRECTION: 280 DEG
DAY: 03
HOUR: 21

PRECIPITATION
NO. OF DAYS WITH PRECIP: 1 NO. OF DAYS WITH REPORTS/ COMPLETE: 0 PARTIAL: 2
NO. OF OBS WITH PAST OR PRESENT PRECIP: 2 NO. OF WEATHER OBS: 11

MARCH — DATA SUMMARY — EB33
AVERAGE LATITUDE 58.5N — AVERAGE LONGITUDE 141.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-04.0	(22 09)	01.5	08.8	(28 00)	159	28
SEA TEMP (DEG C)	03.6	(24 18)	03.9	04.6	(28 00)	164	28
AIR-SEA TEMP (DEG C)	-07.7	(22 09)	-02.4	04.2	(28 00)	158	28
PRESSURE (MBAR)	0988.4	(22 18)	1004.6	1020.7	(25 21)	64	8

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 45

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		2.2					2.2	6.0
NE	2.2						2.2	2.0
E		4.4	8.9	11.1			24.4	19.0
SE		2.2	2.2	2.2			6.7	17.7
S			13.3				13.3	16.0
SW		2.2	13.3				15.6	13.9
W		4.4	26.7				31.1	14.4
NW		4.4					4.4	8.5
CALM								
TOTAL	2.2	20.0	64.4	13.3			100.0	15.2

MAX WIND
SPEED: 30 KNOTS
DIRECTION: 100 DEG
DAY: 26
HOUR: 18

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE:25.6% SEVERE: NONE #OBS: 43

Table 7

Selected Gale And Wave Observations, North Atlantic

March and April 1975

Vessel	Nationality	Date	Position of Ship: Lat. deg.	Position of Ship: Long. deg.	Time GMT	Wind: Dir. 10°	Wind: Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C: Air	Temperature °C: Sea	Sea Waves*: Period sec.	Sea Waves*: Height ft.	Swell Waves: Dir. 10°	Swell Waves: Period sec.*	Swell Waves: Height ft.
NORTH ATLANTIC		MAR.															
MEONIA	DANISH	1	46.7 N	35.5 W	18	29	M 50	1 NM	02		6.8		5	18			
WESER ORE	LIBERIAN	1	37.1 N	27.3 W	00	29	45	10 NM	01	1019.3	15.0	14.0	5	16.5			
FERNDALE	NORWEGIAN	1	43.5 N	38.3 W	18	28	45	5 NM	15		8.0	11.0	5	10	27	9	13
AMER ACCORD	AMERICAN	1	45.5 N	32.4 W	18	28	45	5 NM	02	989.5	10.7	12.8	6	19.5			
LIGHTNING	AMERICAN	2	48.8 N	23.2 W	18	31	50	2 NM	02	982.1	6.8	11.7	3	14.5	29	10	41
EXXON CHESTER	AMERICAN	2	30.5 N	77.2 W	06	23	45	10 NM	90	1002.0	18.0	26.4	4	10			
SEALAND CONSUMER	AMERICAN	2	43.0 N	14.4 W	18	27	45	5 NM	16	1003.1	11.2	12.3			27	6	19.5
MEONIA	DANISH	2	45.5 N	37.1 W	06	29	M 48	1 NM	25		8.7						
BOSTON	AMERICAN	2	33.1 N	75.4 W	12	27	45	5 NM	02	998.3	16.5	25.0	8	11.5			
AMER ACCORD	AMERICAN	2	45.3 N	33.7 W	06	27	45	10 NM	27	1005.5	10.6	12.2	6	19.5			
MARYLAND TRADER	AMERICAN	3	37.4 N	74.4 W	00	30	47	5 NM	23	1003.3	0.0	11.7	6	14.5			
SEALAND CONSUMER	AMERICAN	3	40.7 N	17.4 W	06	30	45	10 NM	16	1013.9	12.3	13.3			32	7	19.5
AMER COURIER	AMERICAN	3	40.8 N	66.5 W	12	25	50	5 NM	26	992.9	3.9	12.7	5	19.5	27	6	24.5
CHEVRON FELUY	LIBERIAN	4	37.1 N	57.6 W	18	24	M 43	5 NM	15	1004.6	15.6	20.0	8	13			
SYLVO	NORWEGIAN	8	46.1 N	12.5 W	12	32	60	5 NM	82	1000.8	8.0	12.0	4	19.5			
SEALAND ECONOMY	AMERICAN	8	48.1 N	12.7 W	18	34	40	10 NM	27	1005.2	10.5	11.2	8	10	30	13	32.5
EXXON SAN FRANCISCO	AMERICAN	9	36.4 N	73.8 W	12	36	60	5 NM	05	1014.9	10.0	23.5	12	19.5	36	>13	23
MITRA	NORWEGIAN	12	38.1 N	51.6 W	06	17	41	10 NM	02	1020.0	16.0	19.0	6	8	20	< 6	10
CHEVRON FELUY	LIBERIAN	13	41.4 N	62.5 W	03	12	M 45	1 NM	02	1009.3	10.0	9.5	5	11.5	13	11	10
EXXON SAN FRANCISCO	AMERICAN	15	33.2 N	77.8 W	00	20	70	> 25 NM	01	1007.5	22.0	20.6			20	12	11.5
RIGOLETTO	SWEDISH	16	43.0 N	54.8 W	12	24	45	1 NM		995.0	3.2	7.0	7	13			
SEALAND PRODUCER	AMERICAN	16	42.2 N	24.6 W	00	29	M 50	2 NM	02	1003.7	12.7	14.0					
AMER ALLIANCE	AMERICAN	16	38.3 N	56.0 W	18	29	42	10 NM	02	1018.3	12.8	20.0	7	14.5	29	12	28
CHEVRON FELUY	LIBERIAN	16	39.3 N	58.0 W	12	27	M 46	5 NM	15	1015.5	8.8	19.4	10	13			
MITRA	NORWEGIAN	16	46.2 N	22.0 W	18	06	45	5 NM	07	1002.0	12.0	14.0	5	19.5			
AMER ARGOSY	AMERICAN	17	44.2 N	41.2 W	18	28	45	5 NM	18	997.8	6.7	12.2					
MITRA	NORWEGIAN	17	46.5 N	20.7 W	00	06	45	> 25 NM	02	1007.0	14.0	13.0	5	16.5			
EXXON JAMESTOWN	AMERICAN	17	37.0 N	74.5 W	12	05	M 45	2 NM	03	1005.8	13.0	11.2	6	10			
AMER ALLIANCE	AMERICAN	18	42.4 N	38.2 W	12	28	48	10 NM	02	1008.4	9.3	15.0	10	41			
AMER ARCHER	AMERICAN	18	45.1 N	33.2 W	18	25	55	5 NM	25	997.0	9.4	12.2	10	29.5			
AMER ARGOSY	AMERICAN	18	44.0 N	41.7 W	00	28	45	5 NM	23	1002.0	5.0	13.9					
EXXON FLORENCE	AMERICAN	18	33.0 N	67.5 W	06	36	50	5 NM	03	1009.0	16.3	21.2	3	10	27	7	11.5
LOS ANGELES	AMERICAN	18	38.0 N	69.5 W	00	09	45	5 NM	20	1017.3	12.2	21.1	7	11.5	09	8	14.5
NORSE PILOT	BRITISH	19	35.0 N	47.1 W	12	01	60	50 YD	55	1000.0	14.1	11.0	5	14.5			
MORMACCOVE	AMERICAN	19	34.4 N	59.2 W	12	03	50	10 NM	01	1024.0	15.0	20.0			03	8	16.5
MORMACCAPE	AMERICAN	19	34.6 N	74.8 W	18	14	45	.5 NM	07	999.3	20.0	22.8	8	14.5	15	9	41
LIGHTNING	AMERICAN	19	49.4 N	16.7 W	06	14	45	5 NM	60	1009.1	8.9	14.0	4	6.5	14	7	21
CARBIDE TEXAS CITY	AMERICAN	20	38.0 N	72.8 W	00	15	45	5 NM	51	1000.3	14.5	12.2	8	13			
SAN JUAN	AMERICAN	20	30.3 N	70.0 W	00	16	47	5 NM	02	1010.5	18.8	21.7	10	19.5			
SAN FRANCISCO	AMERICAN	20	36.5 N	40.6 W	12	33	45	5 NM	02	1000.3	12.3	17.3	6	19.5	XX	X	28
CHEVRON FELUY	LIBERIAN	20	32.3 N	64.3 W	18	16	M 50	1 NM	56	1006.3	20.0	19.0	9	8	03	9	18
FERNSTATE	NORWEGIAN	20	37.5 N	71.0 W	06	15	50	2 NM	07	997.5	17.5	20.0	8	19.5			
JOSEPH LYKES	AMERICAN	20	30.8 N	34.0 W	12	16	50	10 NM	01	1010.0	20.0	19.3	3	8	19	8	10
MORMACCOVE	AMERICAN	20	38.7 N	65.9 W	12	15	55	5 NM	61	1003.8	15.0	15.6			15	8	14.5
OCEANIC	PANAMANIAN	21	38.3 N	73.1 W	00	32	M 45	10 NM	02	1001.0	10.0	13.3	8	13			
AMER ARCHER	AMERICAN	22	39.9 N	62.0 W	06	29	45	2 NM	15	1001.0	9.4	22.2			29	8	16.5
SEALAND VENTURE	AMERICAN	26	39.7 N	35.9 W	06	23	M 45	5 NM	02	1007.1	17.0	14.4	5	6.5	23	6	10
ELIZABETHPORT	AMERICAN	27	37.1 N	58.3 W	18	27	42	10 NM	01	1000.3	13.9	22.2	8	16.5			
SAN JUAN	AMERICAN	27	38.1 N	72.8 W	06	34	47	10 NM	02	1023.0	6.1	12.8	3	10	31	10	11.5
ELIZABETHPORT	AMERICAN	28	37.1 N	58.9 W	00	29	42	5 NM	25	1003.7	10.0	22.2	8	16.5			
VICENTE GUERRERO	MEXICAN	28	25.9 N	97.0 W	06	18	50	5 NM	02	1003.5	23.0	28.0			18	< 6	8
LIGHTNING	AMERICAN	31	40.7 N	65.1 W	18	29	50	10 NM	26	1005.1	4.5	11.7	3	8	29	7	24.5
AMER LEADER	AMERICAN	31	41.0 N	58.8 W	18	29	55	5 NM	02	990.5	8.3	10.0	5	13	29	7	32.5
ZIM MONTREAL	LIBERIAN	31	43.0 N	65.3 W	18	27	50	5 NM	03	997.5	1.0	5.0	6	11.5			
OCEAN STATION VESSELS																	
ATLANTIC H																	
TANEY	AMERICAN	2	38.0 N	71.0 W	18	36	M 52	2 NM	80	989.5	4.5	13.3	8	14.5			
TANEY	AMERICAN	4	38.0 N	71.0 W	00	31	M 44	5 NM	85	1009.1	3.6	12.8	8	18			
INGHAM	AMERICAN	17	38.0 N	71.0 W	18	05	M 45	1 NM	61	1015.6	10.9	15.0	8	16.5			
INGHAM	AMERICAN	18	38.0 N	71.0 W	00	05	M 41	5 NM	03	1020.8	9.6	12.5	10	19.5			
INGHAM	AMERICAN	19	38.0 N	71.0 W	21	16	M 52	2 NM	80	1008.2	18.0	15.8	12	26			
INGHAM	AMERICAN	20	38.0 N	71.0 W	03	16	M 52	1 NM	63	1000.0	16.0	12.4	12	26			
INGHAM	AMERICAN	21	38.0 N	71.0 W	06	31	M 50	2 NM	07	1002.8	9.2	15.2	10	23			
INGHAM	AMERICAN	25	38.0 N	71.0 W	06	20	M 46	5 NM	05	1006.1	21.2	15.8	8	16.5			
TANEY	AMERICAN	27	38.0 N	71.0 W	03	31	M 49	5 NM	07	1023.0	5.0	12.2	7	18			
TANEY	AMERICAN	30	38.0 N	71.0 W	18	24	M 44	5 NM	21	995.3	18.9	15.5	8	16.5			
TANEY	AMERICAN	31	38.0 N	71.0 W	12	31	M 41	5 NM	07	1013.1	6.6	12.4	7	19.5			
NORTH ATLANTIC		APR.															
AMER LEADER	AMERICAN	1	40.3 N	59.4 W	06	32	47	5 NM	02	1006.2	6.7	19.5	6	13	32	8	32.5
ZIM MONTREAL	LIBERIAN	3	31.6 N	74.1 W	18	21	M 42	5 NM	02	1000.5	2[illegible].2	24.0	5	8			
LEMPA	HONDURAN	4	35.4 N	29.9 W	18	32	45	5 NM	02	1007.1	15.5	16.0	7	14.5	32	7	23
ELIZABETH LYKES	AMERICAN	4	36.0 N	30.9 W	06	29	45	5 NM	25	999.7	15.0	17.8	5	11.5			
AMER ALLIANCE	AMERICAN	4	40.8 N	68.6 W	18	26	47	2 NM	85	982.1	1.3	8.3	6	23	22	9	29.5
OGDEN THAMES	LIBERIAN	4	36.0 N	69.6 W	12	30	M 47	2 NM	64	998.0	15.0	19.0					
WILMINGTON GETTY	AMERICAN	4	37.3 N	73.8 W	12	28	60	5 NM	02	1002.4	6.0	13.5	9	23			
EXXON BANGOR	AMERICAN	4	36.9 N	74.2 W	18	31	50	10 NM	03	1004.4	9.2	17.5			31	6	19.5
ALERT	AMERICAN	4	39.5 N	72.5 W	02	28	M 48	5 NM	18	987.1	3.9	6.7	6	13	24	10	29.5
CHANCELLORSVILLE	AMERICAN	4	35.9 N	73.8 W	06	28	42	5 NM	03	1001.7	8.8	12.0	6	11.5			
MOBIL AERO	AMERICAN	5	37.9 N	71.4 W	18	34	60	5 NM	70	999.7	2.7	12.2			32	>13	19.5
MONMOUTH	AMERICAN	5	38.0 N	74.2 W	18	32	45	5 NM	01	1007.8	2.7	10.0	8	16.5			
AMER LEGACY	AMERICAN	5	34.9 N	70.2 W	18	31	47	5 NM	27	1001.7	12.3	18.7	8	23	34	6	23
TEXAS SUN	AMERICAN	5	36.5 N	74.7 W	18	34	45	5 NM	02	1006.5	5.5	13.4	5	8			
RIO MANAMO	LIBERIAN	5	35.9 N	73.6 W	12	32	45	5 NM	02	1004.7	7.7	16.7			34	X	23
ECLIPSE	AMERICAN	5	36.5 N	73.4 W	06	31	50	5 NM	07	1005.8	1.5	21.1	10	19.5	32	>13	24.5
EXXON BANGOR	AMERICAN	5	37.7 N	73.9 W	00	32	50	5 NM	03	1003.7	6.0	13.3			32	6	19.5
BAYANO	BRITISH	5	38.7 N	74.5 W	00	30	45	5 NM	07	1005.0	0.5	10.0	8	11.5			

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C.		Sea Waves+		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.*	Height ft.
NORTH ATLANTIC OCEAN		APR.															
MOBIL AERO	AMERICAN	6	39.5 N	70.4 W	06	36	55	5 NM	70	1000.0	5.6	11.2			36	12	14.5
MOSGULF	NORWEGIAN	6	27.9 N	62.6 W	06	24	M 35	10 NM	15	1005.5	22.0	23.0		13	28	X	32.5
AUSTRAL PATRIOT	AMERICAN	8	32.9 N	56.6 W	06	23	30	10 NM	01	998.3	17.8	17.2			23	10	10
SELANDIA	DANISH	14	38.5 N	42.5 W	12	21	M 45	2 NM	80	1008.0	17.5	16.0	5	13	26	8	10
SELANDIA	DANISH	15	43.5 N	31.3 W	12	20	M 42	1 NM	81	1006.1	16.2	13.0	5	13			
MORMACDRACO	AMERICAN	16	34.4 N	69.4 W	18	30	50	5 NM	02	1003.7	16.7	20.0			30	9	49
R G FOLLIS	LIBERIAN	16	37.3 N	67.6 W	13	25	60	5 NM	62	993.0	18.8	19.0	10	49			
MORMACDRACO	AMERICAN	17	34.9 N	69.8 W	06	32	40	5 NM	01	1006.8	13.4	19.6			31	9	49
R G FOLLIS	LIBERIAN	17	36.3 N	67.3 W	00	27	M 58	2 NM	80	993.5	13.6	19.4		41	30	X	46
AMELIA TOPIC	LIBERIAN	17	37.1 N	64.5 W	12	28	47	2 NM		993.5	13.2	17.0	12	19.5			
R G FOLLIS	LIBERIAN	18	36.1 N	68.0 W	00	33	M 38	5 NM	20	1011.0	15.6	23.0		29.5	33	X	32.5
SEALAND VENTURE	AMERICAN	26	30.0 N	53.9 W	06	02	M 42	10 NM	00	1022.2	17.8	21.1			02	6	8
OCEAN STATION VESSELS																	
ATLANTIC H																	
TANEY	AMERICAN	3	37.7 N	72.0 W	21	27	M 45	5 NM	07	989.2	13.5	16.7	8	16.5	17	7	8
TANEY	AMERICAN	4	37.3 N	72.4 W	03	28	M 55	2 NM	07	997.9	7.6	11.7	8	23			
GREAT LAKES VESSELS																	
EDMUND FITZGERALD	AMERICAN	10	45.7 N	83.6 W	12	27	M 42	10 NM	18		2.0	0.0	11	6.5			

+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kt or waves ≥ 25 ft from May through August (≥ 41 kt or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest wind speed was selected.

ADDRESSES OF NATIONAL WEATHER SERVICE PORT METEOROLOGICAL OFFICES

NOAA National Weather Service Port Meteorological Offices have personnel who visit ships in port to check and calibrate barometers and other meteorological instruments. In addition, port meteorologists assist masters and mates with problems regarding weather observations, preparation of weather maps, and forecasts. Meteorological manuals, forms, and some instruments are also provided.

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Table 8
Selected Gale and Wave Observations, North Pacific
March and April 1975

Vessel	Nationality	Date	Position of Ship: Lat. deg.	Position of Ship: Long. deg.	Time GMT	Wind: Dir. 10°	Wind: Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C: Air	Temperature °C: Sea	Sea Waves†: Period sec.	Sea Waves†: Height ft.	Swell Waves: Dir. 10°	Swell Waves: Period sec.*	Swell Waves: Height ft.
NORTH PACIFIC		MAR.															
PRES MCKINLEY	AMERICAN	1	36.3 N	136.7 W	12	28	35	10 NM	01	1002.4	12.2	13.6	6	32.5	28	7	41
POLAR ALASKA	LIBERIAN	1	47.0 N	157.2 E	18	02	M 44	2 NM	83	996.0	- 2.1	0.0	8	6.5			
ARCO ANCHORAGE	AMERICAN	1	35.4 N	145.7 W	00	34	48	5 NM	03	1013.9	13.0	11.1	5	13	32	6	18
MIDAS ARROW	LIBERIAN	1	45.5 N	138.7 W	00	05	M 42	5 NM	80	1004.4	7.0	9.5	9	24.5			
POLAR ALASKA	LIBERIAN	2	47.5 N	158.3 E	00	02	M 44	5 NM	83	996.0	- 1.4	0.0					
SHING ON	PANAMANIAN	2	30.4 N	151.5 W	18	32	M 43	10 NM	03	1019.0	14.0	19.0	5	10	34	8	16.5
TRANSOCEAN TRANSPORT	PHILIPPINE	2	50.7 N	169.5 E	18	32	M 45	50 YD		977.0	0.5	2.3	10	19.5			
ARCO ANCHORAGE	AMERICAN	2	33.5 N	151.0 W	00	30	45	10 NM	01	1014.6	12.5	13.4	5	13			
GOLDEN RAY	LIBERIAN	3	50.2 N	177.1 E	00	21	M 44	5 NM	04	982.5	2.4	3.5	6	11.5	22	12	23
INDIAN MAIL	AMERICAN	3	50.2 N	167.9 E	00	31	45	2 NM	20	990.9	- 2.2	2.2	4	13	31	6	20
TRANSOCEAN TRANSPORT	PHILIPPINE	3	49.8 N	169.2 E	00	29	M 47	2 NM	26	988.5	1.0	2.3	10	24.5	29	13	32.5
AUSTIN	AMERICAN	4	33.6 N	142.8 W	00	34	55	5 NM	81	1014.6	12.2	17.2	5	10	34	10	18
AMER MAIL	AMERICAN	4	45.0 N	174.5 E	18	17	70	2 NM		995.6	4.4	2.8	8	13			
HONSHU MARU	JAPANESE	5	49.9 N	169.1 W	18	13	M 43	1 NM	07	1019.0	3.5	3.5	8	14.5	14	12	23
JAPAN MAIL	AMERICAN	5	51.3 N	173.7 E	12	16	45	2 NM	18	972.6	1.2	1.7	6	18	13	8	32.5
VAN CONQUEROR	LIBERIAN	5	47.9 N	177.0 E	00	16	M 52	2 NM	61	1003.0	3.0	3.0					
AMER MAIL	AMERICAN	5	44.9 N	175.0 E	00	16	60	2 NM		990.5	8.9	5.0	5	21	12	7	14.5
ARCTIC TOKYO	LIBERIAN	5	53.6 N	178.8 E	18	16	M 50	2 NM		992.0	2.0	4.0					
AMER AQUARIUS	AMERICAN	5	31.2 N	131.5 E	06	05	45	1 NM	12	1008.5	15.8	16.1	3	5	05	10	6.5
KOREAN MAIL	AMERICAN	6	35.7 N	157.2 E	18	18	45	2 NM	21	993.0	12.8	15.0	10	26			
HONSHU MARU	JAPANESE	6	50.0 N	170.9 W	00	14	M 47	.25 NM	07	1005.2	3.5	2.5	10	16.5	14	>13	23
ARCTIC TOKYO	LIBERIAN	6	53.4 N	176.6 E	00	18	M 50	2 NM		989.0	1.0	4.0	5	6.5			
CHRISTIAN MAERSK	DANISH	6	34.7 N	149.3 E	18	26	48	5 NM	02	991.3	14.8	17.5					
PLUTOS	GERMAN	6	38.9 N	176.3 W	18	21	45	2 NM	51	996.6	8.3	11.4	7	13	21	10	16.5
MONTIGNY	LIBERIAN	7	36.7 N	150.7 E	06	33	M 46	2 NM	07	993.7	10.2	16.0	5	14.5	24	9	14.5
KOREAN MAIL	AMERICAN	7	39.0 N	163.3 E	12	20	45	5 NM	02	984.0	11.0	13.0					
KINYO MARU	JAPANESE	7	45.2 N	164.7 W	12	23	M 47	2 NM		994.0	6.0	6.0			20	8	23
VAN PORT	LIBERIAN	7	48.7 N	177.1 W	12	32	M 47	5 NM	02	994.0	1.0	3.0	8	10	19	9	10
BELHUDSON	BRITISH	7	39.2 N	167.0 E	06	18	M 65	.5 NM	83	987.5	11.5	11.0	6	13			
CHEVRON HAWAII	AMERICAN	7	35.1 N	121.4 W	12	14	45	.5 NM	82	1006.2	13.9	9.4	6	16.5			
PACSTAR	LIBERIAN	7	41.0 N	174.7 W	00	29	41	2 NM		998.0	7.0	10.0			29	6	24.5
KINYO MARU	JAPANESE	8	45.9 N	160.6 W	00	24	M 46	1 NM		1003.0	7.0	6.0	6	10			
HONSHU MARU	JAPANESE	8	48.6 N	170.9 E	06	07	M 45	50 YD	73	971.3	1.0	2.0	10	19.5	09	>13	29.5
VAN CONQUEROR	LIBERIAN	9	39.6 N	148.2 E	06	25	M 50	5 NM	02	1006.0	14.0	7.0					
HONSHU MARU	JAPANESE	10	45.6 N	157.3 E	06	29	M 45	2 NM	07	1001.2	- 1.0	0.5	8	13	28	12	18
PRES HARRISON	AMERICAN	10	54.3 N	168.1 W	06	30	45	5 NM	02	980.6	2.8	2.2	3	8	30	< 6	11.5
MONTIGNY	LIBERIAN	10	43.1 N	173.5 E	12	27	M 42	5 NM	58	999.2	3.8	10.0	8	10	30	11	13
NORBU	NORWEGIAN	12	52.7 N	161.5 W	00	26	47	10 NM	03	1003.0	4.0	1.0	3	8	23	7	19.5
MONTIGNY	LIBERIAN	12	47.1 N	172.9 W	06	19	M 43	.5 NM	52	1002.3	6.2	6.0	7	13	20	11	19.5
NORBU	NORWEGIAN	13	52.0 N	168.1 W	00	26	48	5 NM	20	994.0	3.0	1.0	4	16.5	25	8	19.5
NORBU	NORWEGIAN	14	51.5 N	171.9 W	00	31	45	10 NM	02	1011.0	2.0	1.0	4	28	30	7	48
MONTIGNY	LIBERIAN	14	49.4 N	150.2 W	18	29	M 44	5 NM	70	1001.2	2.8	6.0	7	13	29	12	18
TOWER BRIDGE	SINGAPORE	16	42.8 N	172.8 W	06	27	M 42	5 NM	01	1007.0	8.0	10.0	8	16.5	27	13	32.5
SEALAND TRADE	AMERICAN	17	38.2 N	168.6 E	12	15	45	.5 NM	92	1007.1	11.7	12.8	8	13			
THOMAS G THOMPSON	AMERICAN	17	46.1 N	124.3 W	12	18	M 45	5 NM	62	999.3	6.7	8.9			18	7	32.5
CHALMETTE	LIBERIAN	18	35.1 N	147.6 E	18	32	52	2 NM	00	1011.4	10.0	13.0	9	16.5			
SUMMIT	AMERICAN	18	55.1 N	153.2 W	12	31	49	5 NM	02	1005.1	- 4.4	3.4			31	7	11.5
TOWER BRIDGE	SINGAPORE	18	44.4 N	168.9 E	12	02	M 42	.5 NM	61	1001.0	3.5	6.0	6	10	04	8	18
EASTERN BUILDER	LIBERIAN	19	45.8 N	139.3 W	00	29	M 41	10 NM	03	1004.0	5.0	9.0	4	10	29	< 6	14.5
TREIN MAERSK	DANISH	19	32.8 N	149.9 E	00	32	55	10 NM	02	1005.0	10.4	17.0	12	32.5			
EASTERN BUILDER	LIBERIAN	20	45.3 N	146.1 W	18	28	M 48	5 NM	80	999.0	9.0	9.0	3	8			
SEALAND TRADE	AMERICAN	20	48.1 N	154.1 W	12	27	45	2 NM	51	996.0	2.8	5.5	6	11.5	27	>13	14.5
STOLT LLANDAFF	BRITISH	20	46.2 N	143.8 W	18	26	45	5 NM	02	1001.0	6.5	8.0	3	6.5	26	8	11.5
ASHBY MARU	JAPANESE	21	43.2 N	171.9 W	18	07	M 36	.5 NM	65	1005.9	5.0	7.0	8	16.5	07	11	19.5
ARCO PRUDHOE BAY	AMERICAN	21	50.9 N	137.9 W	00	13	45	2 NM	25	977.0	3.5	10.7	5	8	14	10	24.5
SUMMIT	AMERICAN	21	49.9 N	128.7 W	06	13	50	5 NM	62	993.0	4.5	6.6	5	16.5			
STOLT LLANDAFF	BRITISH	21	46.5 N	137.1 W	12	28	55	2 NM	62	993.0	4.5	7.0			28	7	20
SEALAND TRADE	AMERICAN	21	46.6 N	146.4 W	06	30	45	2 NM	10	1003.7	2.2	6.9			28	12	24.5
J M TUTTLE	AMERICAN	21	51.7 N	131.7 W	18	10	45	2 NM	30	981.0	5.6	8.3	2	6.5	17	13	10
EASTERN BUILDER	LIBERIAN	21	45.3 N	146.9 W	00	29	M 60	2 NM	50	1004.0	6.0	9.0			29	8	37.5
ASIA BRIGHTNESS	LIBERIAN	21	45.1 N	141.9 W	18	31	50	1 NM		1005.0	4.0	8.0	7	26	31	9	46
BREWSTER	PANAMANIAN	21	43.6 N	130.2 W	23	27	M 55	1 NM		989.5	7.0	10.0	8	11.5	27	>13	29.5
SANTA MARIA	AMERICAN	22	42.6 N	129.1 W	12	30	45	10 NM	02	999.0	6.7	10.0	5	13	29	10	32.5
SEALAND TRADE	AMERICAN	22	43.5 N	139.7 W	00	32	45	2 NM	05	1009.1	3.9	7.2	12	39			
ASHBY MARU	JAPANESE	22	42.4 N	170.3 W	12	09	M 45	.5 NM	55	1004.8	6.0	8.0	9	18	09	13	19.5
BREWSTER	PANAMANIAN	22	43.7 N	131.8 W	11	30	M 50	1 NM	20	1003.5	7.0	10.5	8	11.5	30	13	31
ASIA BRIGHTNESS	LIBERIAN	22	44.5 N	140.3 W	00	31	50	5 NM	02	1008.0	6.0	8.0	7	29.5	31	8	37.5
SEALAND GALLOWAY	AMERICAN	23	41.0 N	153.0 E	00	11	50	5 NM	10	1000.0	10.0	6.6	12	39			
ASHBY MARU	JAPANESE	23	41.9 N	169.4 W	00	08	M 50	.5 NM	52	1007.5	7.5	8.0	9	18	07	12	19.5
PLUTOS	GERMAN	24	33.5 N	172.7 E	00	05	44	.5 NM	63	999.5	12.2	13.6	7	10	04	10	18
SEALAND GALLOWAY	AMERICAN	25	47.4 N	175.1 W	18	36	45	5 NM	02	989.8	1.7	3.3	5	23			
EASTERN BUILDER	LIBERIAN	25	47.0 N	176.3 W	18	33	M 41	5 NM	02	998.0	2.0	7.0	7	10	36	9	18
CHEVRON HAWAII	AMERICAN	25	40.5 N	126.0 W	18	36	45	10 NM	02	1022.2	9.4	8.3	4	13			
SEALAND GALLOWAY	AMERICAN	26	47.0 N	172.0 W	00	36	50	2 NM	10	985.5	1.7	3.4	5	18			
SANTA CLARA	AMERICAN	26	31.4 N	124.3 W	18	01	45	10 NM	01	1025.0	13.5	14.5	7	13	01	13	19.5
ASIA BOTAN	LIBERIAN	26	54.0 N	160.8 W	00	05	M 42	2 NM	22	986.0	3.0	5.0	6	16.5	05	11	19.5
BAY BRIDGE	SINGAPORE	26	34.3 N	121.4 W	00	32	M 49	2 NM		1010.8	11.5	12.5	9	16.5			
SANTA CLARA	AMERICAN	27	31.0 N	125.9 W	00	35	45	10 NM	02	1024.7	14.0	15.0	8	11.5	34	8	14.5
ASIA BOTAN	LIBERIAN	27	54.6 N	169.9 W	00	05	M 48	1 NM	22	991.0	- 3.0	3.0	XX	26	05	11	39
BREWSTER	PANAMANIAN	29	29.1 N	163.3 W	23	01	M 42	1 NM		1017.5	17.0	21.0	5	11.5	01	7	14.5
MAGLEBY MAERSK	DANISH	30	31.9 N	160.9 W	00	04	50	2 NM	07	1017.8	15.2						
PRES MCKINLEY	AMERICAN	30	35.7 N	177.3 E	06	20	48	5 NM	60	1013.5	16.1	13.9	5	13	19	7	23
ASIA ZEBRA	LIBERIAN	30	37.1 N	142.7 E	18	31	M 43	10 NM	25	1000.2	8.0	6.0	13	19.5			
EASTERN BUILDER	LIBERIAN	30	40.6 N	154.5 E	12	09	M 52	2 NM	80	997.0	6.0	6.0	8	11.5			
EXPORT COURIER	AMERICAN	30	36.0 N	149.6 E	12	24	M 48	10 NM	18	990.3	16.2	15.5	3	5	18	6	11.5
CHALMETTE	LIBERIAN	31	36.8 N	153.0 E	06	29	45	5 NM	02	1000.0	14.5	13.5			28	>13	19.5
EASTERN BUILDER	LIBERIAN	31	38.3 N	153.5 E	06	25	M 35	5 NM	80	992.0	13.0	12.0	5	10	25	6	32.5
ASIA BOTAN	LIBERIAN	31	46.8 N	153.9 E	06	10	M 46	5 NM	03	1002.0	1.0	2.0	7	13	10	11	20
ARCO PRUDHOE BAY	AMERICAN	31	38.4 N	124.3 W	18	34	41	10 NM	03	1018.0	10.6	8.9	7	11.5	35	12	28

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves† Period sec.	Sea Waves† Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.*	Swell Waves Height ft.
NORTH PACIFIC		APR.															
EASTERN BUILDER	LIBERIAN	1	36.5 N	150.7 E	06	25	M 51	10 NM	01	997.0	12.0	18.0	6	8	25	>13	32.5
JOHAN U	NORWEGIAN	1	52.9 N	150.3 W	18	31	47	5 NM	03	1014.0	5.0	7.0					
OCTA	LIBERIAN	1	56.5 N	148.1 W	18	32	M 46	1 NM	68	998.0	2.8	2.0	7	23			
PACIFIC	SWEDISH	1	37.9 N	123.8 W	00	34	32	5 NM	07	1016.0	9.8	10.0	9	32.5			
JOHAN U	NORWEGIAN	2	52.5 N	151.5 W	06	33	43	3 NM	01	1023.0	3.0	5.0		23			
SANTA MARIA	AMERICAN	2	52.9 N	140.2 W	06	27	35	2 NM	71	1000.7	2.3	3.5	5	8	27	8	32.5
NEWARK	AMERICAN	2	56.8 N	144.5 W	00	31	45	1 NM	73	993.6	0.0	2.2	5	10	30	8	14.5
OCTA	LIBERIAN	2	56.6 N	149.0 W	00	31	M 48	2 NM		1005.0	0.3	2.0	7	24.5			
CRESSIDA	PANAMANIAN	3	50.4 N	175.0 E	12	23	M 41	1 NM	63	990.0	4.0	3.0	5	8			
OCTA	LIBERIAN	3	58.5 N	151.6 W	06	32	M 43	10 NM	00	1014.5	0.0	2.0	5	10			
SANSINENA II	AMERICAN	5	47.4 N	131.7 W	00	36	45	10 NM	02	1011.2	7.5	6.7	4	6.5	33	9	19.5
JAPAN BEAR	AMERICAN	5	33.7 N	136.9 E	18	20	M 46	5 NM	02	1002.7	16.7	13.9	5	14.5			
SEALAND TRADE	AMERICAN	6	35.0 N	144.7 E	06	19	43	1 NM		1001.0	16.7	12.8	8	19.5			
AMER LANCER	AMERICAN	6	35.0 N	131.2 W	00	32	50	10 NM	18	1021.0	14.0	12.3	5	14.5			
JAPAN BEAR	AMERICAN	6	34.5 N	139.2 E	00	20	M 53	1 NM			16.7	18.0	5	13			
CHINA BEAR	AMERICAN	6	34.0 N	147.8 E	06	18	47	5 NM	03	1011.2	17.8	18.6	7	16.5	18	10	18
CRESSIDA	PANAMANIAN	6	43.2 N	154.0 E	18	11	M 37	.5 NM	65	994.0	7.0	2.0	9	11.5	11	>13	13
PRES TAFT	AMERICAN	6	35.3 N	146.5 E	06	19	45	2 NM		1005.0	15.6	15.6	6	23			
WINDFORD	LIBERIAN	6	39.1 N	153.0 E	03	20	M 45	5 NM	02	1017.0	14.0	10.0	12	8			
CRESSIDA	PANAMANIAN	7	42.7 N	153.0 E	00	23	M 36	5 NM	65	1003.0	7.0	2.0	9	11.5	23	>13	13
PACIFIC PHOENIX	LIBERIAN	7	34.8 N	172.9 W	12	23	47	.25 NM	90	1017.0	13.0			19.5	23	X	23
PRES POLK	AMERICAN	7	36.6 N	166.2 W	18	28	43	10 NM	15	1010.1	10.0	8.2	8	13			
WINDFORD	LIBERIAN	7	40.0 N	160.1 E	03	18	M 48	2 NM	55	1013.0	11.8	10.0	10	10			
PRES POLK	AMERICAN	8	36.7 N	169.7 W	06	29	50	10 NM	15	1016.0	10.0	12.3	9	13			
TOWER BRIDGE	SINGAPORE	8	49.7 N	171.8 W	06	02	M 41	1 NM	88	1002.0	2.0	3.0	6	16.5	05	>13	29.5
EASTERN FORTUNE	LIBERIAN	9	42.4 N	154.5 E	06	14	M 42	2 NM	63	1009.0	7.0	6.0	4	13	16	7	16.5
OCTA	LIBERIAN	9	54.1 N	162.7 W	00	01	M 46	.5 NM	10	996.5	1.6	2.0	5	11.5			
SUMMIT	AMERICAN	10	54.6 N	163.3 W	06	31	45	2 NM		1011.3	- 3.9	1.6	3	6.5			
PRES MCKINLEY	AMERICAN	17	37.0 N	173.8 E	06	27	43	5 NM	25	997.0	14.4	13.9		23	16	X	39
PHILADELPHIA	AMERICAN	19	57.3 N	145.1 W	00	30	45	5 NM	02	1007.1	0.6	6.4	4	14.5	30	X	29.5
SUMMIT	AMERICAN	19	59.1 N	151.7 W	06	28	45	10 NM	02	1015.5	- 4.4	5.0	5	16.5			
VAN CONQUEROR	LIBERIAN	21	48.0 N	134.5 W	18	19	M 44	2 NM	63	1007.0	6.0	7.0					
CRESSIDA	PANAMANIAN	21	38.1 N	146.6 E	18	05	M 42	2 NM	50	1012.0	9.0	17.5	6	8	05	12	8
MIDAS RHEIN	LIBERIAN	22	49.7 N	131.5 W	06	16	M 45	.5 NM	07	1000.0	7.0	4.0	10	16.5			
MAREN MAERSK	LIBERIAN	22	34.7 N	143.7 E	06	02	50	2 NM	51	1009.5	14.0	18.0	8	23			
ASIA BEAUTY	LIBERIAN	22	39.3 N	159.2 E	12	05	M 41	2 NM	20	1006.8	8.0	13.0	9	6.5			
CRESSIDA	PANAMANIAN	22	38.8 N	148.1 E	00	05	M 42	5 NM	03	1012.0	9.0	16.0	6	8	05	12	8
SUMMIT	AMERICAN	24	54.3 N	165.8 W	12	10	60	.5 NM	75	985.4	0.6						
MIDAS ARROW	LIBERIAN	24	52.7 N	171.9 W	18	28	M 42	2 NM	80	976.0	1.0	4.0	5	16.5	28	10	24.5
NORTH STAR III	AMERICAN	26	56.3 N	158.4 W	12	32	M 45	10 NM	70	1003.7	- 2.8	2.8					

† Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kt or waves ≥ 25 ft from May through August (≥ 41 kt or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest wind speed was selected.

Rough Log, North Atlantic Weather

June and July 1975

ROUGH LOG, JUNE 1975--The number of storm tracks was near normal, and their paths fairly consistent once over the ocean, but they were relatively weak even for this month. The primary track was from the vicinity of Newfoundland through the Denmark Strait. This differed from climatology in that it normally passes south of Iceland. Secondary tracks were from northern Quebec to southern Greenland, and from the west-central ocean (40°N, 60°W) toward the Faeroe Islands. The Great Lakes had their share of storms, as many cyclone paths intersected over or north of Lake Superior. The majority of these dissipated before reaching the ocean.

The central pressures of the pressure centers were very close to their normal values. The 1010-mb low center was displaced some 900 mi east-northeastward of its climatic position: 61°N, 30°W versus 57°N, 60°W. The 1024-mb Bermuda-Azores High was nearly normally located, at 33°N, 37°W. The 1020-mb isobar extended much farther to the east and northeast than normal, stretching to the northwestern coast of Spain and France and encircling the United Kingdom. The pressures were slightly higher than normal over and near the New England coast, and over western and northern Europe.

There were two significant negative anomaly centers, a 3-mb between Iceland and Kap Farvel with the low center, and another, larger 3-mb center over the west-central ocean. The positive areas were along the coasts: a 5-mb near Cape Chidley, a 5-mb over central Greenland, a 6-mb over Scotland, and a 5-mb near the Canary Islands.

At the 700-mb level, a Low was centered over Greenland, with a sharper-than-normal trough off the North American coast. A ridge which is generally west of the European coast was over the United Kingdom and Bay of Biscay. The trough that is normally over Spain was shifted to the western Balkans, with a weak Low off Portugal. A long, narrow ridge extended coast to coast, and into Africa, between approximately 18° and 30°N. The anomalies were not especially significant, being positive near the coasts about 50° and 20°N, and negative over the central ocean and northern seas.

The first tropical cyclone--Amy--formed during the last week of the month.

Extratropical Cyclones--On the 2d, there was a HIGH over the Mississippi Valley, with a front separating it from the Bermuda HIGH. On the 3d, a wave formed on the front over South Carolina. On the 1800 chart, two centers had developed; one moved up the coast to Cape Cod, and the other, eastward to sea. On the 5th, their circulations combined, and, by 1200, only one 993-mb center remained, near 40°N, 58°W. The MAN-

CHESTER VIGOUR (38.5°N, 66.5°W) radioed 40-kn winds and 23-ft seas. Southeast of the center, but behind the cold front, the MINERAL OUGREE (36.5°N, 52.5°W) reported 35-kn gales. At 0000 on the 6th, the HEILBRONN, near 36.5°N, 53.5°W, also reported 35-kn westerly winds and 15-ft southwesterly swells.

By 0000 on the 7th, the 990-mb LOW was at 44°N, 36°W, and the TOYOTA MARU found 35-kn gales near 37°N, 35°W, as did two Soviet ships east of the occlusion. The STATE OF TAMIL NADU, at 43°N, 33°W, was pounding into 50-kn winds, 10-ft seas, and 20-ft swells. Closer to the center, a SHIP (45°N, 28°W) was battered by 50-kn westerlies on her northerly course.

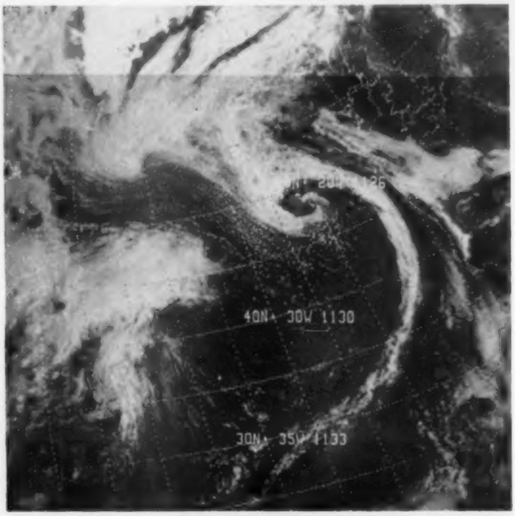

Figure 39.--With its well-marked center near 50°N, 20°W, the LOW has a sharply defined cold front trailing to the southwest.

At 1200 on the 8th (fig. 39), two ships south of the center had minimal winds, but reported seas or swells of 26 and 33 ft. They were the ATLANTIC FOREST and KASIMOV. On the 9th, the LOW deteriorated rapidly and, on the 10th, disappeared.

This storm originated over the central Great Plains, moved across Lake Superior and southern James Bay, and was over Newfoundland at 1800 on the 19th. At 1200, the VC 8062 drilling ship reported 40-kn gales near 44°N, 58°W. The central pressure of the LOW was 982 mb, at 0000 on the 20th, at 51°N, 52°W. The C. S. ALERT was headed northeastward with 40-kn beam winds. The LOW was moving northeastward only slightly faster than the ALERT. At 1200, the ALERT suffered 50-kn south-southeasterly winds on her easterly heading. Seas of 28 ft were pounding her starboard beam (fig. 40). The LOW, at 976 mb, was tracking more northerly, at 0000 on the 21st, and the ALERT was maintaining nearly the same position relative to the center. She continued receiving 50-kn winds. On this observation, the seas were 26 ft, and the swells 16 ft. The SKAFTAFELL, at 53°N, 46°W,

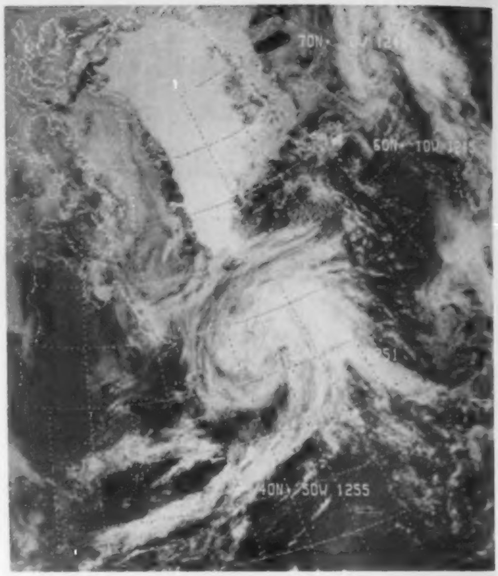

Figure 40.--Under this canopy of clouds, the ALERT was being pounded by high waves.

was plotted as 95 kn, but may have been in error as many elements were missing, and the gradient did not appear to support that wind value.

The LOW continued a north-northeasterly track, with only isolated minimum gale-force reports. At 1200 on the 22d, the BASHKIR, near 64°N, 07°W, had 40-kn gales.

On the 23d, the LOW split into two centers astride Iceland, and the original one disappeared.

This LOW tracked eastward from Hudson Bay. It moved over the Labrador Sea, on the 27th, and was probably producing gale-force winds, but there were no ship reports in the area. At 0000 on the 28th, the 990-mb storm was approaching Kap Farvel. To the south, off Trinity Bay, the HAVDRILL measured 35-kn winds and 12-ft seas. On the 29th, at 0000, the NELLA DAN was off Angmagssalik, Greenland, with rain and snow showers and 40-kn winds. The LOW was moving up the east coast of Greenland through the Denmark Strait and rapidly weakening.

Tropical Cyclones--During the period June 24 through 26, a weak surface trough of low pressure persisted over Florida and the adjacent Atlantic waters. A weak circulation formed off the Florida east coast, just north of the Bahamas, by the evening of June 26. The tropical depression moved northward at about 9 kn, during June 27, with a lowest pressure around 1012 mb and highest winds of 22 to 26 kn. The development of a well-organized, warm anticyclone in the upper atmosphere during the early stages of this system contributed to its rather rapid strengthening into tropical storm Amy, on the 29th. The storm skirted the North Carolina coast, and the area of maximum winds and heaviest rainfall remained over the open waters

of the Atlantic.

From June 29 to July 3, Amy moved on a meandering east-northeasterly course, with an average forward speed of less than 9 kn. On both July 1 and 2, minor troughs in the westerlies caused Amy to slow and turn to a more northerly course, with brief threats to the Canadian Maritime Provinces. On the 3d, a major trough developing over southeastern Canada produced a rapid northeasterly acceleration, with the center of Amy passing some 150 mi southeast of Cape Race, Newfoundland, on the 4th. The high winds and rains associated with the storm did not affect Newfoundland, and the system gradually lost all its tropical characteristics over the cold waters of the far North Atlantic.

Damage produced by tropical storm Amy was light and confined to erosion along the Outer Banks of North Carolina. Tides of 2 to 4 ft above normal, caused by prolonged northeasterly winds and combined with large swells associated with the circulation of Amy, damaged many of the beaches. Some state highways near the beach were temporarily under water. Rainfall of 2 to 4 in occurred along the immediate coast of North Carolina, but was much lighter inland.

During most of its life, Amy had many of the characteristics of a subtropical storm. The region of maximum winds was well removed from the center, and midtropospheric temperatures were not as warm as might be expected in a tropical storm. The minimum pressure was 981 mb, but the maximum sustained winds of 60 kn were less than might be expected with this pressure. However, when the LOW attained winds of gale force, data indicated it was more tropical than subtropical, so it was named Amy. Because of the proximity to the coast, the name was retained throughout to avoid confusion in public releases.

Casualties--The WILLIAM R. ADAMS (10,713 tons) and the IPSWICH PIONEER II collided in fog at Harwich Harbor, England, early on the 6th.

ROUGH LOG, JULY 1975--This was a near-normal month over the major shipping lanes. The number of cyclones and the pattern of their tracks very closely resembled climatology. The primary track that affected shipping extended eastward from Labrador to about 40°W, then northeastward toward Iceland. There were less traveled tracks across Scotland and into Baffin Bay. The majority of the storms occurred the first and last weeks of the month.

The Bermuda-Azores High was the outstanding pressure feature, at 1026 mb, centered near 35°N, 50°W. Its anticyclonic circulation dominated from the Great Plains of the United States to the Urals of Russia, and from 15° to 50°N (fig. 41). These, of course, are gross boundaries.

In the oceanic area of primary interest, south of 60°N, there were no anomalies greater than 3 mb, and they were mostly positive.

North of 60°N, the negative anomalies were large because of much lower pressure than normal from both Baffin Island and the Greenland Sea toward the North Pole. The lowest pressure was 1000 mb, near 82°N, 100°W, while climatologically the Low is 1008.6 mb near 62°N, 70°W. The largest anomaly was minus

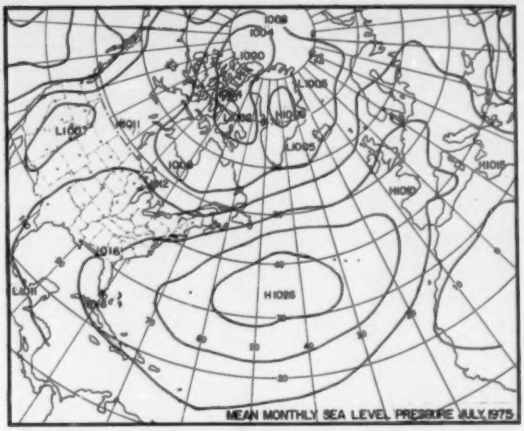

Figure 41.--The mean sea-level pressure chart for July 1975.

12 mb, near 82°N, 100°W. There was a minus 8-mb center over the Greenland Sea, and a minus 5-mb near 64°N, 30°W.

Hurricane Blanche formed over the Sargasso Sea on the 24th.

Extratropical Cyclones--The only really significant cyclonic storms this month were the two tropical cyclones--Amy, which formed in June, and Blanche. The Bermuda-Azores HIGH stood out as the dominant pressure system and circulation even on the individual synoptic charts. There was no storm even approaching the "Monster of the Month" category.

This storm formed as a 1010-mb wave, on the 9th, near 46°N, 46°W. It moved eastward across the top of the HIGH with winds of strong-breeze force. On the 11th, the center turned northeastward and started deepening. The circulation also expanded as the HIGH drifted southeastward.

At 0000 on the 12th, the 992-mb storm was centered near 50°N, 19°W, and stationary. The KLAUS SCHOKE was near 51°N, 22°W, with 35-kn gales. The LOW remained stationary for about 48 hr and, on the 14th, moved over northern Scotland. On the 15th, a small center developed in a trough trailing southwestward out of the LOW. At 1200, the SPEYER, at 49°N, 24°W, about 150 mi southwest of the new center, found 35-kn gales.

By the 16th, the new center could no longer be analyzed, as the original LOW moved into Sweden.

The weather was so mild this month that I am reduced to mentioning individual wind reports. During the middle of the month, the Bermuda HIGH was centered near 40°N, 60°W, at about 1033 mb. The gradient on the north side increased as two weak parallel fronts drifted southward. At 0000 on the 15th, the drilling ship VC 8062 measured 35-kn westerly winds, at 0000 on the 15th.

A wave developed, on the 16th, on the northern of two fronts previously mentioned, and moved eastward with

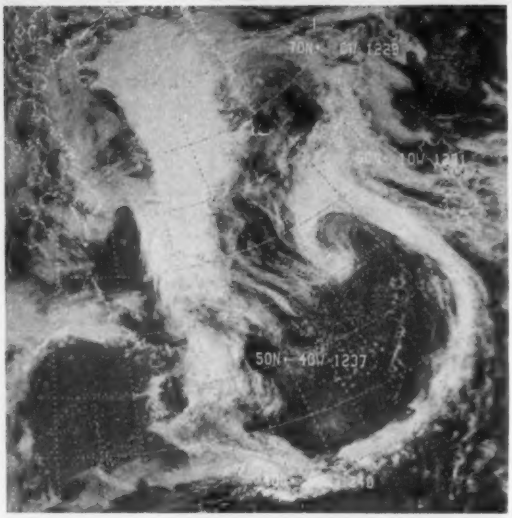

Figure 42.--The surface LOW is covered by high clouds and not visible. The high winds that hit the SALTERSGATE were located below the comma-shaped cloud, which is generally associated with a vorticity maximum.

no severe weather. On the 17th, another wave developed on the front, north of Trinity Bay. The HIGH was weakening and drifting southward. By 1200 on the 18th, it was 992 mb near 54°N, 32°W. On the 19th, the center took a northeasterly course and, at 1200 (fig. 42), the SALTERSGATE (56.5°N, 28°W) was hit by 45-kn winds, 7-ft seas, and 16-ft swells. At that time, the LOW was at 59°N, 24°W.

At 0000 on the 20th, Ocean Weather Station LIMA (which replaced INDIA and JULIETT) measured 40-kn gales and 18-ft seas. The LOW was moving due north and, by the 21st, this center disintegrated into several small centers.

This LOW formed in a col area south of Kap Farvel, late on the 19th. The previously described LOW was to the east, and another was centered near Disko Island, Greenland. The LOW moved eastward at a pressure of about 990 mb. At 0000 on the 21st, it was near 59°N, 20°W. Ocean Weather Station LIMA, at 56.5°N, 20°W, had 35-kn gales, which were whipping up 16-ft seas and 20-ft swells.

On the 21st, the LOW moved to the east of Iceland and then eastward. It increased its area of circulation, absorbing the remains of the previously mentioned storm. On the 22d and 23d, the center stalled near 63°N, 07°W, as a minor LOW moved around its southern edge. On the 24th, this new LOW became the primary cyclone.

Another report of a single wind: The 40 kn was reported by the GOLDEN ORCHID, near 47.5°N, 34°W, at 1200 on the 28th. The 1030-mb Bermuda-Azores HIGH was stationary near 41°N, 37°W. A cold front lay about 60 mi to the south. Both seas and swells were coded as 7 ft.

Tropical Cyclones--Blanche, the season's first hurricane, had its beginnings as a tropical wave which moved off the coast of Africa on July 14. As the wave entered the Caribbean region, it appeared to elongate and then divide into two systems. One part tracked northwestward as a cloud mass from which a depression formed, about 500 mi north of the eastern tip of the Dominican Republic, on the 24th. The southern part continued westward across the Caribbean Sea and the Yucatan Peninsula, and formed a tropical depression in the southwestern Gulf of Mexico on the 25th.

The first depression gradually turned toward the north and north-northeast, during the next 2 days. In this interval, reconnaissance and satellite data indicated that it hovered on the brink of becoming a tropical storm. The threshold was probably crossed during the early hours of the 26th, when a reconnaissance aircraft found a central pressure of 1004 mb. This point marks the beginning of tropical storm Blanche on the official track. Meanwhile, the second depression intensified as it crossed the southwestern Gulf of Mexico, and was on the verge of becoming a tropical storm when it passed over Tampico, Mexico, later the same day.

As Blanche turned toward the northeast, its potential for further intensification was dependent upon the impact of an approaching cold front moving off the North Carolina coast. However, the front rapidly weakened before cooler air could penetrate the storm's inner core, and Blanche steadily deepened, partly in response to the baroclinic effect of an upper trough to the west. Blanche reached hurricane strength as the central pressure fell to 987 mb, during the early hours of July 27 (fig. 43). At this time, the hurricane was at the same location as tropical storm Amy was 2 wk earlier.

Whereas Amy followed a meandering track toward the northeast, Blanche moved north-northeastward to-

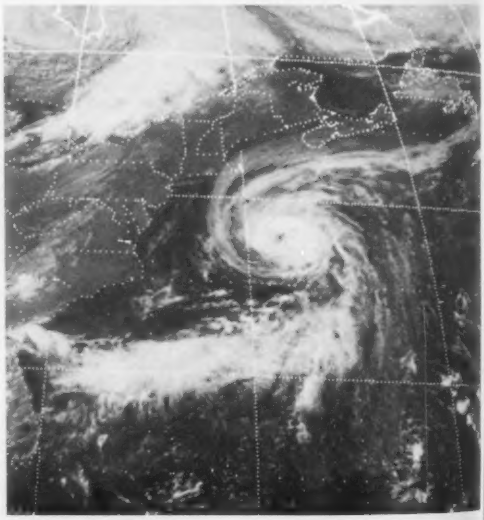

Figure 43.--Hurricane Blanche has a textbook shape as she reaches hurricane strength. The feeder clouds are well defined.

ward Nova Scotia. As a deepening upper trough moved through eastern Canada, Blanche accelerated to a forward speed of about 25 kn at the time of landfall at Cape Sable, Nova Scotia, about daybreak on the 28th.

During the 12 hr prior to landfall, the hurricane reached its maximum intensity. Highest sustained winds were about 75 kn, and the lowest pressure was 980 mb. The MIECZYSLAW KALINOWSKI encountered 50-kn winds, at 1200 on the 28th, some 60 mi southwest of the eye.

The lowest pressures at land stations were 987 mb at Western Head, near Cape Sable, at 1330 on the 28th, following a 3-hr pressure fall of 16 mb; and 988.7 mb at nearby Shelburne, at 1200, after a 3-hr fall of 18 mb. Some maximum wind measurements are: Halifax, sustained winds of 45 kn, with gusts to 70 kn, at 1422; Western Head, sustained winds of 47 kn at 1200; and Grindstone Island, sustained winds of 61 kn at 1800.

There was no loss of life due to Blanche. Considerable minor damage occurred, mostly in eastern Nova Scotia, consisting mainly of small boats washed ashore, and trees blown down. Rainfall was not excessive. The greatest accumulation was 3.1 in, in Chatham, New Brunswick. The rains proved beneficial, bringing an end to a prolonged dry period over the region.

Casualties--The 10,043-ton Liberian-registered ORIENTAL ARGOSY ran aground in heavy weather, on the 9th, at San Jose, Guatemala. The Cypriot-registered DELPHI grounded as a result of a sudden squall, at Matazanas Bay, Cuba. An estimated 70 persons were drowned when a motorvessel carrying about 100 passengers sank in a storm, near the mouth of the Lakoundje River, on the 10th. It was enroute from Douala, Cameroon, to Libreville, Gabon.

Rough Log, North Pacific Weather

June and July 1975

ROUGH LOG, JUNE 1975--The number of cyclones traversing the North Pacific appeared near to slightly above normal. The primary paths were normally located over the western ocean, but had a more easterly orientation. Climatically, the primary paths stretch from Japan to the Aleutians at 180°. From there the track parallels slightly south of the islands into the Gulf of Alaska. Another path comes out of the central ocean into the Gulf. This month's primary track was east-northeasterly from Japan to near 160°E, where it split; one segment followed the traditional path toward Adak Island, and the other moved eastward to 170°W, and then followed the climatic midocean path into the Gulf of Alaska.

The Pacific High was even more the dominant feature this month. It was near 39°N, 144°W, at 1029 mb, about 300 mi northeast of its 1022-mb climatic position. The area of low pressure is an east-west-oriented trough over the Bering Sea according to climatology, but this month there was a 1011-mb center near 50°N, 180°, and a 1010-mb center near Bethel, Alaska. The pressure along the Asian coast was slightly lower, and along the North American (other than Alaska) slightly higher, than normal.

The chart was fairly confused except over the eastern ocean. A plus 6-mb departure center was near 42°N, 134°W. A plus 3-mb center was south of Kamchatka. There was a negative 4-mb center in midocean, near 47°N, 179°W, and another negative 4-mb center over southern Japan.

The upper-air pattern at 700 mb closely resembled the climatic pattern in height and configuration. The significant difference was a deeper, sharper trough in the vicinity of 180°.

There were two tropical cyclones over the eastern North Pacific--hurricane Agatha and tropical storm Bridget.

Extratropical Cyclones--The North Pacific was very quiet this month, and especially so if you discount the two tropical cyclones in the eastern waters.

This storm formed as a wave on a front in midocean. It circled around an older LOW moving toward the Gulf of Alaska and, at 1200 on the 1st, was 994 mb near 42°N, 169°W. By 0000 on the 3d, the 988-mb LOW was at 52°N, 161°W. Southeast of the center, the HAKKAI MARU reported 35-kn winds and 16-ft swells. Twenty-four hours later, the LOW had traveled to 54.5°N, 153.5°W. The ROBERT BANKS (52°N, 151°W) and the CHIKUGO MARU (49°N, 153°W) were cruising in 40-kn winds, with seas and swells up to 16 ft. The DAISHIN MARU fared slightly better, with 35-kn winds and 10-ft seas near 50.5°N, 149°W. Far to the east near the coast (53°N, 135°W), the NEWARK also suffered 35-kn winds and 8-ft seas.

Figure 44.--The CURACO MARU was in the clear (black) inverted-"V"-shaped area, west of the frontal band, of the cloud mass on the right. Another LOW is centered near 46°N, 175°W.

The LOW started filling and, on the 5th, turned northward. It was barely moving northwestward when it disappeared on the 6th.

Like the previous storm, this one formed in midocean, but farther south. It had its beginning as a 1015-mb center near 32°N, 179°W. It developed a circulation which, by 0000 on the 6th, covered over 700 mi in diameter. At the same time on the 7th (fig. 44), the 996-mb LOW was near 44°N, 161°W. The CURACO MARU was near 39.5°N, 161°W, with 45-kn winds and 15-ft waves. This was the highest extratropical wind plotted on the charts this month for this ocean.

As most storms in this area of the Pacific do, this LOW also traveled toward the Gulf of Alaska. At 0000 on the 8th, the 990-mb LOW (50.5°N, 156°W) brought 35-kn winds to the REXTAR, near 50°N, 151°W. By the 9th, the storm was curving to the northwest and the Alaska Peninsula, where it dissipated on the 10th.

This LOW formed on the triple point of an occlusion, near 39°N, 164°E, on the 8th. A ship northeast of the center radioed 35-kn winds and 13-ft waves at that time. The 990-mb LOW was moving northeastward, and the PAPYRUS MARU encountered 40-kn winds, near 42.5°N, 171°E, ahead of the newly formed occlusion. On the 9th, the EASTERN KIKU had 35-kn gales, again ahead and east of the front where the stronger winds were blowing.

On the 9th and 10th, and early on the 11th, the surface LOW moved eastward under the influence of the upper-air circulation. The KIZAN MARU, 100 mi west of the center, and the SEA-LAND EXCHANGE, 240 mi northeast of the center, were both hit by 40-kn winds. At 0000 on the 11th (fig. 45), the JAPAN MAIL, near 43.5°N, 177°W, had 40-kn northwesterlies and only 7-ft seas, but 21-ft swells.

Although this was not a particularly deep LOW, it had a large circulation. The J.H. TUTTLE, south of the Shumagin Islands, found 35-kn gales. The RYOKO MARU, south of the center at 40.5°N, 166°W, had 16-ft swells.

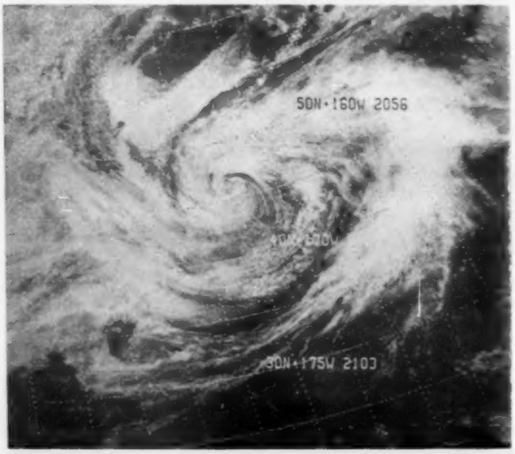

Figure 45.--This looks like a wild winter-type storm. The high swells were found south of the center.

As the storm approached the Gulf of Alaska, it lost its main upper-air support and started to deteriorate. On the 14th, it no longer existed.

The Pacific HIGH migrated northwestward, starting about the middle of the month. It settled near 43°N, 155°W, as a gross location. This blocked the eastward movement of cyclones beyond about 165°W. Later in the month, the HIGH was slowly retreating southeastward. A weak frontal wave managed to move into the Gulf of Alaska, where the gradient was already relatively weak. On the 24th, a 1004-mb LOW was evident (fig. 46). The GRAND GLOBE, near 54°N, 152°W, was sailing into 35-kn northwesterly winds. On the 25th, the ASIA BOTAN was headed into 40-kn winds and 16-ft seas and swells.

The LOW remained essentially stationary and slowly filled, leaving only a weak gradient along the coast on the 26th.

Figure 46.--No circulation center is readily apparent over the Gulf of Alaska, as the system was obscured by high clouds where the circulation was not closed

This was one of the cyclones diverted northward by the large HIGH over the eastern ocean, late in the month. It started as a frontal wave, east of Tokyo Bay, late on the 24th. It moved eastward as a weak 1000-mb LOW, slowly spreading its influence until early on the 27th. At that time, it was pushing against the HIGH and moving into southerly upper-air winds around the upper-air LOW, which was near 50°N, 180°. On the 27th and 28th, it raced northward to cross the Aleutians at 170°W, at 1800. On crossing the islands, it braked to a crawl as the 982-mb LOW moved away from the upper-air LOW. Unimak Island measured

35-kn gales. On the 30th, Cape Romanzof measured 40-kn gales. On the 1st, the storm disappeared as it crossed the Bering Strait.

Tropical Cyclones, Eastern Pacific--A number of tropical disturbances were charted in the eastern North Pacific Ocean during the last 2 wk of May, but the areas of squalls and thunderstorms would build, die, and rebuild several hundred miles from the initial point, on successive days.

An area about 250 mi southwest of Acapulco showed signs, on June 1, of greater instability than the others. Windspeeds of 25 kn were reported by the PRESIDENT JEFFERSON, at 15.1°N, 97.3°W, at 1800. At 0000 on the 2d, the SHUNYO MARU reported an east-southeasterly 25-kn wind and a 1005.4-mb pressure in the same area. No other vessels reported in the area, but the 2345 Synchronous Meteorological Satellite (SMS-2) photograph indicated a tropical depression with 30-kn winds, close to 13.5°N, 99°W. Film loops showed its movement to be toward the west-southwest at 12 kn. The LOW was forecast to curve westward and then northwestward, and to intensify.

When the depression reached its southernmost point, near 13.1°N, 100.4°W, at 0600 on the 3d, it increased to tropical storm intensity with 35-kn winds and was named Agatha. Further intensification took place, with winds increasing about 5 kn each 6 hr through 1800 on the 3d, during which time the storm traveled on a northwesterly course at a speed of about 10 kn. A 2116 satellite picture showed development to hurricane intensity near 15.4°N, 103.7°W, about 150 mi southwest of Zihuatanejo, with 65-kn winds and gales out 250 mi in the northeast quadrant and 125 mi elsewhere.

The strongest winds suggested by satellite pictures were 70 kn, at 0000 on the 4th. The hurricane continued into the night, but decreased to a tropical storm at 1200. An apparent jog in the track was the result of the difference in the location of the center between nighttime infrared- and daytime visible-spectrum pictures. Note comparable visible and infrared pictures, at 2345 on the 3d, in figure 47.

After analyzing all the data and forming the "most probable track" of the storm, it was decided that the northeasterly movement was probably indicated as a result of a slight error in the storm's location, at 0600 and 1200 on the 4th. These errors were translated to the forecast, which then placed the storm onshore near Puerto Vallarta, about 0600 on the 6th. At 1800 on the 4th, a new track was developed, with the storm continuing northwestward from near 18°N, 105°W.

Agatha weakened to a tropical depression at 1200 on the 5th. At 1800, the center was analyzed at 19.3°N, 106.4°W, based on 20- to 25-kn winds reported by the J.V. CLYNE, the MELVILLE, and the NORDIC HERON. The storm dissipated about 120 mi south of the Tres Marias Islands.

A tropical depression developed about 500 mi south of the tip of Lower California, well west of the usual formation zone for tropical cyclones in the eastern North Pacific Ocean, at 1800 on June 27.

As usual, initial movement of the depression was uncertain, but a general westerly direction was followed at a speed of 6 kn for the first 12 hr. When the depression intensified to tropical storm Bridgett, near 15°N, 111°W, at 1200 on the 28th, its course changed to northwesterly, and the speed increased to 8 to 10 kn. This movement continued as gradual intensification took place. The KOPAA, heading southeastward, sailed southwest and south of the center, on the morning of the 29th, when Bridgett had 50-kn winds. The highest windspeed the KOPAA reported was 25 kn, at 1800 on the 29th and at 0000 on the 30th.

Bridgett changed to a westerly course at 17.3°N, 115°W, after the KOPAA passed, and then southwest-

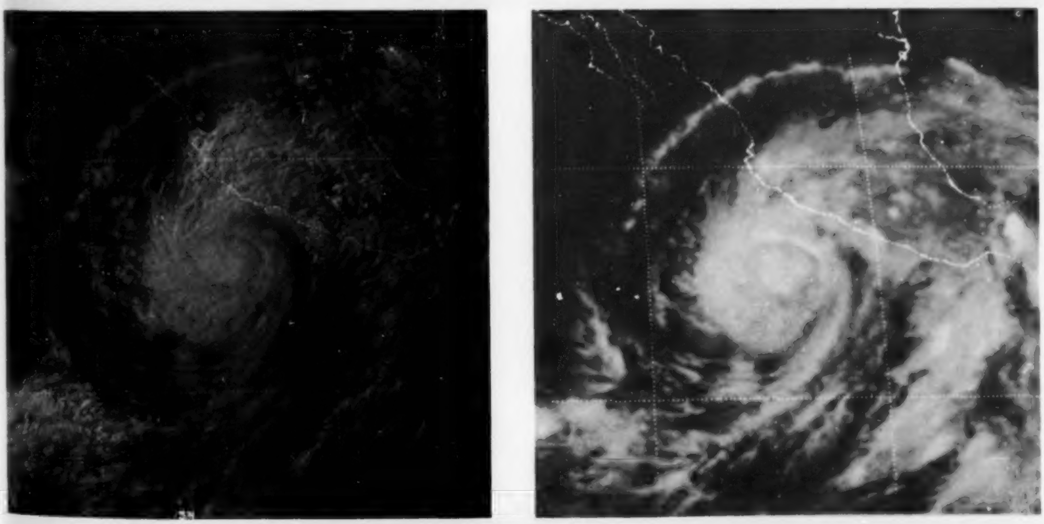

Figure 47.--Hurricane Agatha at 2345 on June 3. Both images were recieved simultaneously from SMS-2--the left is the visual channel, and the right, the IR channel. Agatha is about 600 mi southeast of Cabo San Lucas.

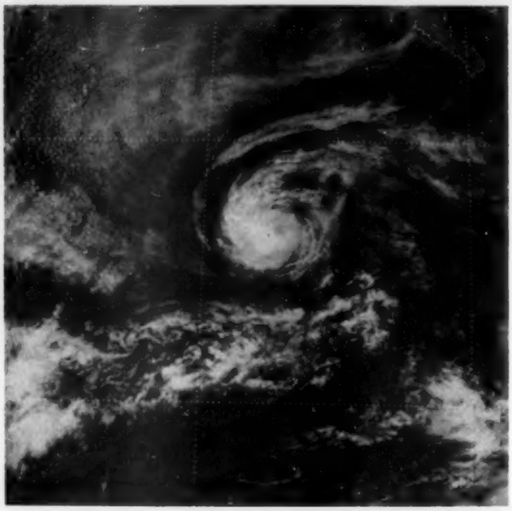

Figure 48.--Tropical storm Bridgette is about 600 mi southwest of Cabo San Lucas, at 2145 on the 30th. The detached ITCZ (Intertropical Convergence Zone) can be seen to the south, and stratus clouds to the northwest.

erly, approaching no other vessel as a storm (fig. 48). The CHAOMING outran the storm westbound, on July 1 and 2, reporting regularly as she traveled.

At 0600 on the 2d, Bridgett became a depression, near 15°N, 120°W, with 30-kn winds. Continued cloudiness, somewhat supported by reports from fishing vessels in the area, indicated that a circulation remained for several days near 14.4°N, 122.5°W, but there were insufficient data to warrant upgrading the circulation to tropical depression status.

Casualties--The 231,799-ton Japanese supertanker EIKO MARU ran aground, in poor visibility of 1.2 km in Tokyo Bay, while trying to avoid collision with another ship on the 4th. On the 20th, the Japanese submarine OYASHIO and 1,573-ton GOSHU MARU collided in the Inland Sea during dense fog.

ROUGH LOG, JULY 1975--The cyclone tracks this month were diverse, and fewer in number than normal. They moved eastward from the Japanese Islands to about 180°, and then northeastward toward Alaska. The climatological track is northeastward from Japan into the Bering Sea.

High pressure was the dominant feature over the majority of the ocean (fig. 49). A 1025-mb HIGH was centered near 35°N, 153°W, compared to the 1026-mb climatic High near 39°N, 150°W. A small 1008-mb LOW was centered near 53°N, 180°, with a trough indenting the HIGH as far south as 40°N. The mean climatological pressure pattern does not indicate a closed Low over the marine area.

The major anomaly centers were both negative: a 9-mb centered near 48°N, 175°W, associated with the trough, and a 6-mb near 51°N, 150°W, associated with another trough in the Gulf of Alaska.

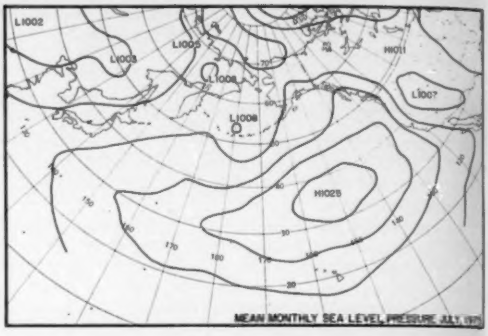

Figure 49.--The mean sea-level pressure pattern for July 1975.

The upper-air pattern was near normal except for the reflection of surface troughing. Climatology indicates troughing at 700 mb over the western Bering Sea, with a south-southwestern orientation. This month, there was a closed circulation near 54°N, 179°W, with a southerly trough, and another near 56°N, 148°W, with a southeasterly trough off the North American west coast.

There were four tropical cyclones over the eastern North Pacific: hurricane Carlotta, hurricane Denise, tropical storm Eleanor, and tropical storm Francene. The western North Pacific hosted tropical storm Mamie and supertyphoon Nina.

Extratropical Cyclones--In the first week, a LOW had moved up the Kuril Islands from Japan. At 1200 on the 6th, a 999-mb LOW was analyzed near 45°N, 165°E, at the point of occlusion. This LOW moved southeastward with near-gale-force winds. At 1200 on the 7th, the 993-mb LOW was near 42°N, 177°E, and the PRESIDENT VAN BUREN was near 38.5°N, 179.5°W, with 35-kn winds and 13-ft seas.

By the 8th, this LOW had expanded its circulation by absorbing the parent LOW. The CORNELIA MAERSK was well to the south, near 34°N, 173°E, with 35-kn gales. At 1200, the SEA-LAND COMMERCE (39°N, 170°W) had heavy rain and gales. The LOW was now moving north-northwestward. The center crossed the Aleutians near 177°W, about 0600 on the 9th. At 1200, the GAVRIIL DERSHAVIN, just south of the Andreanof Islands, found 35-kn northerly winds. At 0000 on the 10th, Cold Bay recorded 35-kn winds from the south. On the 11th, the LOW stalled near 57°N, 180°, and filled.

This storm formed over the Sea of Japan, late on the 10th. It raced along the 39th parallel until late on the 12th, when it turned northeastward. At 1200 on the 13th, the 986-mb LOW was near 48°N, 177°W, and the SEIUN MARU (40°N, 174°W) and the ZEEBRUGGE (35.5°N, 174°E) both reported 35-kn gales just east of the front. At 0000 of the 14th, the HONGKONG SUCCESS found 40-kn gales along the front on her westward track (fig. 50).

The LOW moved over the Alaska Peninsula on the 15th, and eastward into the Gulf of Alaska on the 16th.

it was filling, and only breezes were blowing around its center.

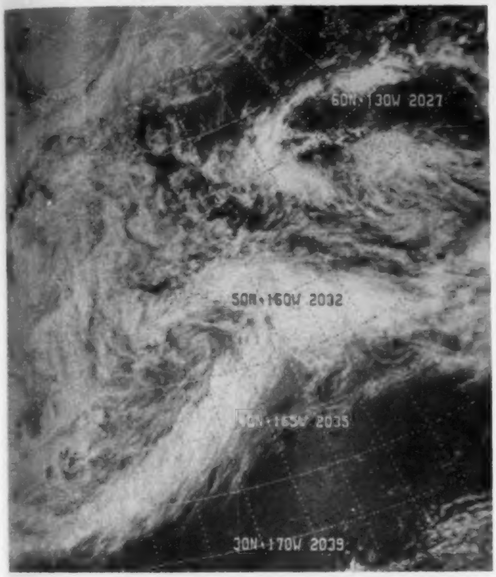

Figure 50.--The LOW has moved to approximately 48°N, 169°W, at 2033 on the 13th. The ships experiencing gales are all hidden under the clouds.

The Gobi Desert spawned this LOW on the 17th. It moved over the Sea of Japan, on the 20th, a well-developed storm at 990 mb. At 0000 on the 21st, it was over the Bering Sea north of Ostrov Beringa. The TOYOTA MARU No. 11 was near 51°N, 165°E, and slightly south of the cold front, with 35-kn gales and 13-ft swells.

The LOW was moving very slowly toward the east over the cold water. The JAPAN MAIL was north of Umnak Island, at 0000 on the 22d, and was being tossed by 45-kn winds. The DAIHO MARU was south of the center and north of Kiska Island, with 35-kn winds. The LOW drifted eastward and disappeared on the 26th.

A LOW formed in the col area over the Bering Sea between two HIGHs. It moved southeastward and then northeastward, late on the 21st. On the 22d and 23d, it stalled near 51°N, 151°W, and deepened to 983 mb. At 0000 on the 23d, the VAN CONQUEROR (50°N, 139°W) was washed by heavy rain and 40-kn winds. Northwest of the center (55°N, 154°W), the JAPAN MAPLE had 35-kn gales supporting 16-ft seas and 18-ft swells. At 1200, the HILLYER BROWN was off Chignik, Alaska, headed toward Kodiak Island, with 45-kn northerly winds. The waves were 15 ft (fig. 51).

On the 24th, the LOW was moving northeastward again, but filling. By the 27th, it no longer existed.

Tropical Cyclones, Eastern Pacific--As tropical storm Bridgette passed 100 mi south of Clarion Island, headed west-southwestward, an area of squalls and thunderstorms began developing 420 mi south-southeast of

Figure 51.--A near-typical Gulf of Alaska storm with the clouds coiled into the center. The sea heights were the most important aspect of this cyclone.

Acapulco. The cloudiness was moving westward at about 10 kn, and development was indicated in the forecasts. Special bulletins were begun, at 0600 on the 2d, for tropical cyclone Three, forecast to become a tropical storm in 24 hr. The KAPAA reported 25-kn winds in squalls 130 mi north of the center, at 0900 on the 2d, and 35-kn winds 150 mi northeast of the center, at 1500. The later report suggested tropical cyclone Three had intensified to tropical storm Carlotta, and advisories were issued.

Further intensification was almost in textbook style. The storm was moving toward the west-northwest and northwest, at 10 to 12 kn, becoming a hurricane with 65-kn winds, near 12.5°N, 108.2°W, by 1800 on the 3d, and 100- to 110-kn winds from 0000 on the 5th, at 15.8°N, 111.7°W (fig. 52), through 1800 on the 6th, at 17.3°N, 117.9°W.

Figure 52.--Carlotta (16.3°N, 112.7°W) has a very distinct "eye" about 20 mi in diameter. This Infrared image, at 0645 on the 5th, indicates the winds near the center are 105 kn. Denise is a tropical disturbance near 11°N, 96°W.

Weakening began, about 0600 on the 6th, but the ERIDGE reported south-southwesterly winds of 45 kn, 200 mi southeast of the center, at 1200 on the 7th, when the hurricane still supported winds of 75 kn. Tropical storm intensity began, at 0000 on the 8th, near 17.4°N, 121.3°W, with the center moving west-northwestward at 8 to 10 kn. The ERIDGE passed 60 mi north of the center, at 2100 on the 8th, with 35-kn winds. The SHINYU MARU and DAISHIN MARU both reported well south of the center, at 0000 and 0600 on the 8th, but these reports indicated no more than a storm at some distance to the northwest.

The KRAIGHERB passed 120 mi north of Carlotta, at 0900 on the 9th, with 30-kn winds. When about 200 mi east of the center, she altered her course to pass south of oncoming Denise, 900 mi east-northeast of Carlotta.

No vessels were near the center of a large unstable area near 11°N, 93°W, at 1800 on the 4th, but reports from the AMERICAN LANCER, CHEVRON AMSTERDAM, KAPAA, and the SAN JUAN EXPORTER indicated a circulation had developed. The depression was followed west- and northwestward on satellite pictures and charted with the aid of peripheral reports from the AMERICAN LEADER, ASTRID BAKKE, CEDARBANK, CHEVRON AMSTERDAM, MARITIME CHALLENGE, NEDLLOYD DELFT, PRUD OCEANJET, RICE QUEEN, SANTA MAGDALENA, and the UNIWERSYTET WARSAWSKI, as a tropical depression through 1800 on the 6th, near 13°N, 101°W.

The depression intensified to tropical storm Denise, at 0000 on the 7th, with 45-kn winds reported by the PGXY, 30-kn winds by the EURYBATES, and 20-kn winds by the PRUD OCEANJET. As the storm reached 15°N, 103°W (200 mi south of Manzanillo), at 0000 on the 8th, its course changed to more westerly. At this time, the storm was considered a hurricane. Although winds along the coast, from Cape Corientes to Acapulco, are normally strong southeasterlies under these circumstances, they were reported as only 15 to 25 kn. The hurricane steadily increased in intensity to 120 kn, by 1200 on the 9th, with the strongest reported wind only 30 kn by the PLEIAS and the FIDELITY R, at 1800 on the 9th (fig. 53). The course of the hurricane then changed to southwesterly, and it weakened slowly. The PSDY sent a SHRED report of northwesterly winds of 45 kn, from 150 mi west of the center, at 0000 on the 10th. The storm continued southwestward, slowly weakening and becoming nearly stationary from 1800 on the 10th to 0600 on the 11th, near 13.7°N, 113.5°W. After the 12-hr "stationary" period, Denise began moving northwestward at about 10 kn.

The CABRILLO, a tuna boat just off Clarion Island at 1800 on the 11th, was heading southwestward, as Denise, with 80-kn winds some 200 mi to the south, was moving northwestward. The CABRILLO, aware of the location and intensity of the storm, contacted the Hurricane Center for information and advice. The storm and boat were on an intercept course, with the meeting scheduled for 0500 on the 12th. The advice was to sail eastward for 6 to 12 hr and then resume the southwesterly course. The CABRILLO reports regularly in the Tuna Fleet and is an old hand at evading tropical cyclones.

The CETRALYRA was headed northwestward about

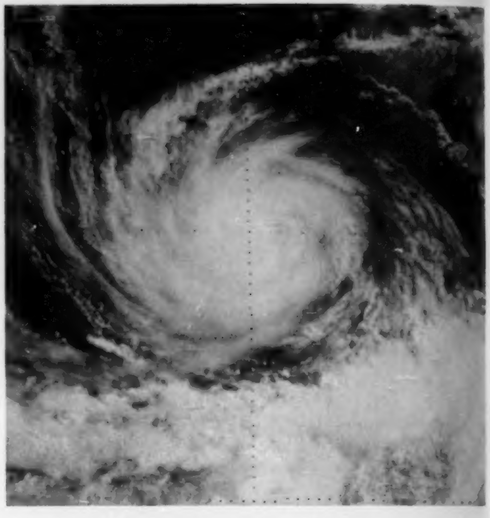

Figure 53.--Hurricane Denise exhibits a near-classical configuration, on the 9th, near 15.1°N, 109.5°W, with 115-kn winds indicated by the Dvorak technique. Thin cirrus obscures the eye.

100 mi east of the hurricane, at 0000 on the 12th, and was moving at about the same speed as Denise. She reported 40-kn winds. These increased to 60 kn, by 0000 on the 13th, when the CETRALYRA reported the lowest pressure in the storm--993 mb. She altered her course to pass 120 mi south of the center, at 1800 on the 13th, with 30- to 40-kn winds.

By the time Denise reached 19.9°N, 118.8°W, she had weakened to tropical storm intensity, becoming a depression near 21.2°N, 118.8°W. She dissipated 12 hr later.

A persistent area of thunderstorms 120 mi south of Acapulco, at 1800 on the 10th, led to issuing a bulletin on tropical cyclone Six. Movie loops of satellite pictures showed cyclonic circulation with signs of intensification, so the cyclone was upgraded to tropical storm Eleanor. Acapulco reported 30-kn winds, at 1200 and again at 1800 on the 10th, but vessels reporting in the area were not numerous enough to pinpoint the location of the center (fig. 54).

Eleanor moved north-northwestward for 6 hr, northwestward for 18 hr, and then northward to go on shore near Manzanillo, at about 0000 on the 12th. At that time, the LUDWIGSHAFEN reported a 998.8-mb pressure and a south-southwesterly 35-kn wind, about 75 mi southeast of the center. The FERNFIELD reported 30-kn winds, 30 mi southwest of the center; the A8MW, a westerly 30-kn wind, 30 mi south of the center; and Manzanillo, a westerly 15-kn wind, 20 mi northwest of the center.

No damage was reported to vessels, and it is not believed rainfall was heavy enough to cause more than minor damage to shore installations.

Tropical storm Francene began as a disturbance near 11.5°N, 95°W, about 1200 July 25, moving northwest-

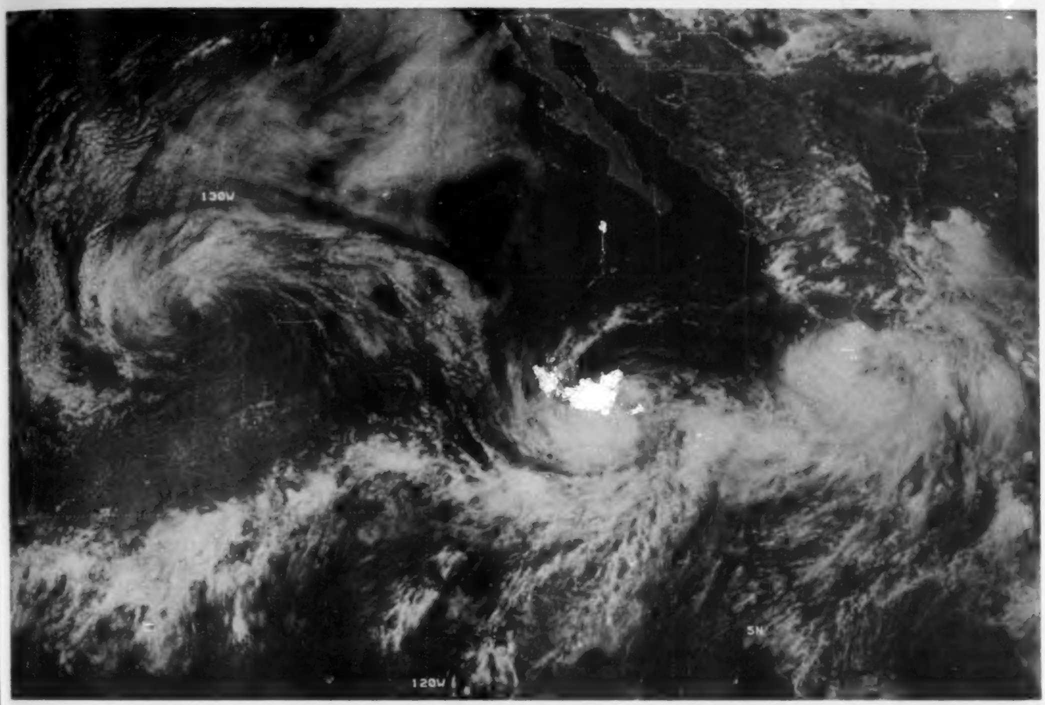

Figure 54.--The Eastern Pacific Hurricane Center was busy at the time this image was received, on the 10th. Tropical storm Eleanor is shown on the right, hurricane Denise in the center, and ex-hurricane Carlotta on the left.

ward at 20 kn, with winds of 30 kn in squalls. The disturbance continued on a northwesterly track, but slowed as it organized and intensified to tropical depression Seven, at 0600 on the 27th, near 16.4°N, 102.8°W. The track became more westerly, and the disturbance developed to tropical storm intensity near 16.5°N, 104.5°W, at 1800 on the 27th.

A westerly movement of 10 kn continued for 24 hr, to 16.4°N, 107.5°W, when Francene weakened to a depression with 25-kn winds. A northwesterly track began at 1200 on the 29th, and its speed increased to 15 kn as weakening continued. By 0000 on the 30th, only a minor circulation was indicated in satellite pictures, so bulletins were discontinued. A tropical disturbance was indicated in high seas bulletins for another 12 hr; then even those were dropped.

Tropical Cyclones, Western Pacific--Mamie and Nina broke a 6-mo tropical cyclone drought, in late July. Mamie, a weak tropical storm, popped up on the 27th, just south of Iwo Jima, while Nina, a potent supertyphoon, came to life on the last day of the month, in the middle of the Philippine Sea.

Mamie traveled a west-northwesterly course, but lasted just 3 days. Her strongest winds were estimated at 35 kn on the 28th. By the time she reached the Ryukyus, all that was left was a weak depression.

Nina was another story altogether. Before July was finished, Nina was a tropical storm. Before August was a day old, she was a typhoon. Her course was west-northwesterly toward Taipan. Nina reached supertyphoon strength, on the 2d (fig. 55), when 130-

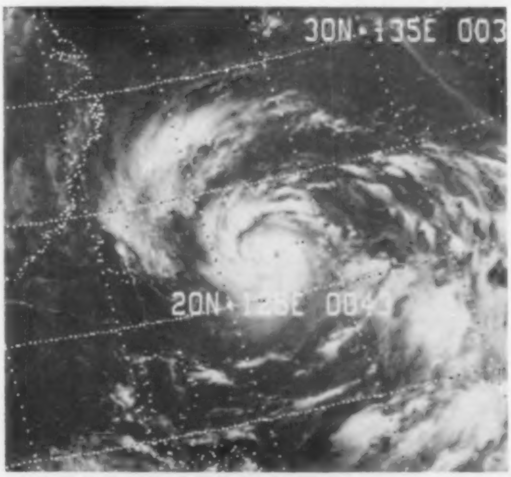

Figure 55.--Nina is at supertyphoon strength and approaching Taiwan, early on August 2.

kn winds blew close to her center. Gales extended out to 200 mi--nearly 500 mi in the northeastern quadrant. This was her peak, since she was fast approaching landfall. On the 3d, Nina, still a typhoon, crossed Taiwan, made the short hop across the Formosa Strait to mainland China, and continued to weaken.

Casualties--A Liberian vessel identified as the UNITED WARRIOR was beached near Jidda, Saudi Arabia, after hull cracks developed during bad weather. The freighter TSUKIBOSHI MARU (423 tons) and the ore carrier KINOKUNI MARU (35,774 tons) collided in dense fog on the Inland Sea, on the 16th. Two crewmen were injured. Two other vessels collided off Kashima Port that day, with no casualties. They were the 997-ton KOWA MARU and the 1,272-ton No. 12 TOZAI MARU.

The British-registered KANISHKA, Houston for Calcutta, reported heavy-weather damage on her voyage.

Marine Weather Diary

NORTH ATLANTIC, OCTOBER

WEATHER. Storms in the middle and higher latitudes increase in frequency and energy during October. The westerlies have pushed southward, and the 1002-mb Icelandic Low, centered about midway between Iceland and southern Greenland, is deeper and larger than it was in September. The Azores High, centered near 34°N, 35°W, is only slightly weaker (at 1020 mb) than in the preceding month, but it has diminished in size.

WINDS. North of 40°N, the prevailing winds are westerly and generally of force 4 to 6 north of 50°N, and force 3 to 5 between 40° and 50°N. The exceptions are: southerly over the Norwegian Sea, southwesterly over the North Sea, Baltic Sea, and adjacent waters, variable near the Icelandic Low, and light (force-2) northwesterlies through north- to southeasterlies around the Davis Strait. South of 40°N, northeasterly winds prevail of force 3 to 4. Southeasterly force-3 winds blow near the Equator between South America and Africa. Northwesterly winds of force 2 to 3 are prevalent over the Mediterranean Sea.

GALES. Both the frequency of and the area subject to gales increase markedly over the previous few months. Winds of force 8 or more can be expected oceanwide north of about 40°N, with a frequency from 5 to over 20 percent. The highest frequencies occur over a small area south of Greenland's southern tip, the Greenland Sea, and the northern portion of the Norwegian Sea. An analysis of eight Ocean Station Vessels north of 40°N indicates that gales generally last less than 1 day over these waters.

EXTRATROPICAL CYCLONES. The temperature contrast off the Atlantic coast, from Labrador through the Carolinas, is conducive to cyclogenesis. Other principal areas of cyclogenesis lie over midocean within an egg-shaped area oriented in a northeast-southwest fashion and comprising a 250- to 300-mi-wide area between 56°N, 23°W, and 48°N, 37°W; over the Bay of Biscay; within the coastal area from Marseilles east-southeastward to Naples; over all but the extreme southern part of the Adriatic Sea; over the Skagerrak, the Kattegat, and the Baltic Sea to about 61°N; off the northern Norwegian coast; east of Iceland; and off the Denmark Strait coast of Greenland. There are more extratropical cyclones than in September, but primary storm tracks are similar, although most are displaced a little farther south. The secondary cyclone track over the northwestern Mediterranean area has lengthened and become of primary importance. Primary tracks are also found over North America from Kansas across the Great Lakes to James Bay, and from James Bay to the Labrador coast. From the Newfoundland-Labrador coasts, the main track is toward Iceland. Another shorter track exists, about 5° latitude south of the main track in midocean. A single track extends from south of Iceland to northern Norway. Occasionally, North Atlantic extratropical storms, being of considerable intensity, generate hurricane- or near-hurricane-force winds.

TROPICAL CYCLONES. The hurricane season continues into October, but after the middle of the month, the probability of a tropical storm occurrence diminishes rapidly. An average of 3 to 4 tropical storms will occur each 2 yr, and about half will develop to hurricane strength. The vast majority of the storms develop before the 21st of the month. Most October storms form over the western Caribbean, but some are spawned near the Lesser Antilles.

SEA HEIGHTS. During October, sea heights of 12 ft or more are usually encountered 10 percent or more of the time over the open ocean north of about 40°N (excluding most of the Norwegian Sea), over the Gulf of Lions, and over central Hudson Bay. An area of 20-percent frequency extends southward out of the Denmark Strait, then eastward south of Iceland to the Faeroe Islands, and westward around Kap Farvel into the Labrador Sea. The southernmost point of the southern boundary is about 57°N, near 35°W. A sec-

ond small area, about 4° in diameter, is centered near 50°N, 40°W. The areas described above very closely approximate the 10-percent frequency for waves of 20 ft or greater.

VISIBILITY continues to improve during October, compared with the previous month. Frequencies of 10 percent or more of visibility less than 2 mi are now found in only three scattered areas--the southern Davis Strait and northern Labrador Sea, over waters due east of Newfoundland, and from the southern reaches of the Denmark Strait southeastward to the Faeroe Islands and then north-northeastward to the Greenland Sea. As in September, the cold waters north of Iceland entertain an area of 20- to 30-percent frequency of visibility less than 2 mi, and a small area (within this larger area and centered near 68°N, 18°W) where visibility less than 2 mi exceeds 30 percent of all observations.

NORTH PACIFIC, OCTOBER

WEATHER. October marks the transition to winter conditions over the northern latitudes of the North Pacific. The Aleutian Low, lying off Cape Newenham, Alaska, has deepened 4.5 mb (as compared to September) to 1002.5 mb, while the subtropical High has become a flat east-west ridge, centered roughly along the 33d parallel, containing a maximum pressure of about 1020 mb.

WINDS. Between 40° and 60°N, westerly winds predominate, with forces 4 to 6 most frequent. However, northwesterlies and northerlies prevail over the eastern Bering Sea, easterlies dominate the Gulf of Alaska, and winds off the coast of British Columbia normally blow from the southwesterly quarter. North of 60°N, the winds are northerly to northeasterly at force 3 to 5. From 30° to 40°N, directions are more variable, with northeasterly and northerly winds prevalent east of Honshu, and northwesterlies common east of the dateline, shifting to northerly near the California coast. Force-4 winds constitute the largest percentage frequency within the above latitudinal belt. The northeast trades, which average slightly less than force 4, prevail between the Equator and 30°N. Northerly force-3 winds are the general rule out from the Gulf of Tehuantepec. The winter monsoon is now well established over Asiatic waters, penetrating as far south as Indochina.

GALES. The chances of encountering winds of force 8 or higher increase appreciably in October, particularly in the middle and higher latitudes. The highest incidence of gales occurs between 48° and 56°N, from Kamchatka eastward to about 140°W, with over 10 percent of the wind observations over most of these waters revealing gales. Ships plying the central Bering Sea as far north as the 63d parallel are also laced by gale-force winds more than 10 percent of the time. There is a gradual decrease in frequency southward--gales are infrequent south of 30°N over the central ocean, 35°N over the western ocean, and about 44°N above eastern waters. Nevertheless, gales are observed between 5 and 10 percent of the time over the typhoon-troubled waters near Taiwan, and those southwest of Japan.

EXTRATROPICAL CYCLONES. The frequency and intensity of extratropical cyclones increases in October. The principal sources of storms, or cyclogenesis, are the Mongolia-Manchuria area and the seas south of Japan. Other areas are along the Aleutian Islands, and over the midocean slightly north of latitude 40°N. The primary storm tracks extend from across Sakhalin and south of Japan toward the Near Islands. From there, the track parallels the Aleutian Islands into the Gulf of Alaska. Another track comes out of the midocean source area into the Gulf of Alaska. A secondary track departs the Near Islands for the Bering Strait.

TROPICAL CYCLONES. Three or four tropical cyclones can be expected to develop over the tropical waters of the Far East. On the average, two or three reach typhoon intensity. Most of these tropical cyclones form at low latitudes in an area extending from the Philippine Islands to about 155°E. Their early movement is generally west-northwestward, and most recurve east of the Philippines or Taiwan and sweep up along the east coast of Japan. A smaller number move across the Philippines into the South China Sea; a still smaller number reach the Asiatic mainland.

In the tropical waters of the eastern North Pacific, tropical cyclones are less frequent than in September, averaging about two per year. Roughly half of these storms reach hurricane intensity at some time in their lives. October tropical cyclones follow less regular tracks than those of September. After developing off the coast of southern Mexico-Guatemala, or near the Revillagigedo Islands, a large percentage of these storms will move inland over Mexico, south of about 30°N.

SEA HEIGHTS. The frequency and area of high waves increase, especially over the northern shipping lanes. The area bounded by approximately 43°N, 160°E, 145°W, and the Aleutian Islands, has 12-ft or higher waves over 10 percent of the time. In general, the area from coast to coast between 30° and 55°N will have seas 12 ft or greater, 2 to 10 percent of the time.

VISIBILITY. Percentage frequencies of low visibility decrease in October. Visibility less than 2 mi occurs 10 percent or more of the time north of a line drawn from Ostrov Karaginski eastward to a point northeast of the Pribilofs, and then southwestward across the Fox Islands to a point near 42°N, 175°W. From there, the line extends eastward across the 155th meridian, and then northward to Kodiak Island.

NORTH ATLANTIC, NOVEMBER

WEATHER. While normally November is considered a transitional period between fall and winter weather over northern waters, this month occasionally develops some of the severest weather of the winter season. Most rough weather is confined to north of 45°N, except along the coast of the United States, where there is an increase in winter-type LOWs. Over the Great Lakes Region, two primary storm tracks--of Alberta and Colorado LOWs--converge into an area of maximum cyclone frequency, contributing in a large measure to rough weather toward the close of the Lakes' navigation season. The Icelandic Low (1002 mb) is still centered between Iceland and southern Greenland. The Azores High has shifted eastward and is centered near 33°N, 29°W; its central pressure has risen slightly to about 1021 mb.

WINDS north of 60°N are quite variable at about force 4 to 5, although these winds tend to come from the northerly quarter west of Iceland, and from the southerly quarter east of that island nation. Westerly winds, force 4 to 6, prevail over most of the ocean between 40° and 60°N. Between the latitudes of 30° and 40°N, force 3 to 4 winds are of variable direction, except east of the Azores, where a noticeable northerly component prevails. The northeast trades, averaging force 3 to 4, extend from 30°N southward to 10°N. Between 10°N and the Equator, southeasterlies (force 3) are predominant.

GALES. The frequency of gales over northern and middle latitudes increases substantially in November. Winds of force 8 or higher occur 10 percent or more of the time over most areas north of about 35°N over western waters; north of about 40°N over the central ocean; and north of about 44°N over eastern waters, including the southern half of the North Sea. A 10-percent frequency of gales is encountered on the Mediterranean only over the Gulf of Lions. Frequencies are generally less than 10 percent, however, over the waters between Iceland and southern Greenland (near the center of the Icelandic Low), over a relatively small area about 200 mi northwest of the western Irish coast, and over and south of the Irish Sea. Frequencies of 20 percent or more occur in the Davis Strait north of 63°N, south of Greenland in the vicinity of 55°N, 45°W, and over most of the Greenland and Norwegian Seas.

EXTRATROPICAL CYCLONES. The principal track of extratropical LOWs is northeastward from the waters off Cape Cod, across Newfoundland to Iceland, and then through the Norwegian Sea. Sometimes these cyclones will approach Iceland from the central part of the North Atlantic Ocean. Other major tracks lead from Hudson Bay to the Davis Strait, and from the Gulf of Lions to Italy.

TROPICAL CYCLONES are infrequent in November. Usually, one storm in 3 yr may be expected, and about half will develop to hurricane intensity. Most of these storms develop over the Caribbean Sea or eastern Gulf of Mexico, and are soon following a northeasterly path out over the main body of the North Atlantic.

SEA HEIGHTS of 12 ft or more are encountered more than 10 percent of the time on most of the ocean north of about 40°N and south of the Davis Strait and the Norwegian Sea, and on the Mediterranean Sea in the Gulf of Lions and the northern Aegean Sea. The frequency increases to 20 percent or more over most of the waters between 47° and 60°N, and extending into the Denmark Strait.

VISIBILITY less than 2 mi reaches a frequency of 10 percent north of a line drawn from the waters around, and 200 mi south of, Kap Farvel west-northwestward to Saglik, Labrador (55 mi northwest of Cod Island); and north of another line extending from Angmagssalik, Greenland, to northwestern Iceland, then across land to the Vesturhorn (eastern Iceland), then eastward to 64°N, 07°W; it then stretches north-northeastward across the Norwegian Sea to the waters north of Norway. An area of frequencies exceeding 20 percent or more lies north of Iceland between 67° and 72°N, and westward from 05°W to Greenland.

NORTH PACIFIC, NOVEMBER

WEATHER. November is often a stormy month north of 35°N over western waters, and about 40°N over the eastern ocean. There have been years when November was the stormiest month of the winter season, but generally the weather is not too severe, and there may be quiet periods lasting several days. South of 40°N, the probability of severe extratropical storms diminishes rapidly with latitude. During November, the Aleutian Low, near 57°N, 170°W, is well established over northern latitudes, with a central pressure of 1000 mb. The Pacific subtropical High, at 1021 mb, is slightly stronger than in October and is centered near 33°N, 140°W. Off the Chinese coast, pressures are higher than during October because of the buildup of the cold Asiatic High.

WINDS. Over the ocean north of 55°N, northerly winds (force 4 to 6) prevail, except over the eastern Bering Sea, where winds are variable, and the Gulf of Alaska, where easterlies ard northeasterlies are most common. With the exception of the area east of 140°W, where southerly and westerly winds are prevalent, westerly winds (force 4 to 6) predominate between 55° and 35°N. Variable winds near force 4 are most frequent between 35° and 25°N, except over the Yellow Sea and waters off Japan, where northerlies predominate. The northeast monsoon (affecting areas west of 140°E) and the northeast trades blow steadily at about force 4, south of 25°N. Lighter force-2-to-3 winds are the rule over the southern limits of the South China Sea, east of the Gulf of Siam. Northerly winds blow steadily out from the Gulf of Tehuantepec, off Mexico's south coast. They reach gale force between 5 and 10 percent of the time just west of the gulf.

GALES occur 5 percent or more of the time north of about 35°N. An area of 5- to 10-percent frequency is also found over the northern reaches of the South China Sea, including the Formosa Strait and the Luzon Strait, and west of the Gulf fo Tehuantepec, as mentioned above. Actually, a frequency of 10 percent or more is found over most of the waters north of 39°N, with the exception of the eastern Pacific east of 154°W (south of 50°N) and the waters east of the Kamchatka Peninsula. A small area of maximum frequency, where gales occur 20 percent or more of the time, is centered about 225 mi southeast of the southern tip of Kamchatka.

EXTRATROPICAL CYCLONES. The main storm tracks extend northeastward from the Japanese Islands to the western Aleutians, and then east-northeastward to the Gulf of Alaska. Another primary cyclone track enters the gulf from an area in the central ocean near 47°N, 169°W. In November, there are more LOWs passing over the Gulf of Alaska than any other part of the Northern Hemisphere; this is also true of 5 of the following 6 mo.

TROPICAL CYCLONES. On the average, two or three tropical cyclones develop over the western North Pacific in November. Two of these usually reach typhoon intensity. The region of most frequent formation is in the vicinity of the central and western Caroline Islands; the tropical cyclones either travel west-northwestward over the Philippines and the South China Sea, or recurve near 15°N, 132°E, to pass east of the Japanese Islands.

Tropical storm frequency over the eastern North Pacific drops rapidly for November, averaging about one every 3 yr. None have developed to hurricane intensity. Tropical storms very seldom occur in the central North Pacific--maybe one every 20 yr. When these late-season storms do develop in the eastern ocean, their direction of movement is usually more northerly than westerly.

SEA HEIGHTS. The area with 12-ft or greater seas and a frequency of 10 percent is bounded by the Aleutian Islands, 158°E, 43°N to 160°W, where the latitude drops to 35°N, and a line from 35°N, 150°W, to the Queen Charlotte Islands. A small area between Hong Kong and Taiwan is also affected, as is a large part of the Sea of Okhotsk. High-swell observations are found north of 30°N, with a tongue extending to the Equator east of the Hawaiian Islands. These observations are more frequent off the State of Washington coast, south of Kodiak Island, and east of the Kuril Islands.

VISIBILITY. Frequencies of low visibility (less than 2 mi) greater than 10 percent lie north of a line drawn from Mys Terpeniya, Sakhalin, eastward across the central Kurils, and then north-northeastward to the waters east of the Komandorskiye Islands. From there, the line stretches northeastward to St. Lawrence Island and the Seward Peninsula. Two smaller regions of 10-percent or greater frequency are centered over the Bering Sea, near 54°N, 173°W, and over the midlatitudes of the eastern North Pacific, near 46°N, 146°W.

One of the first lighthouses in the world was 400 ft high and constructed in 331 B.C. in Alexandria, Egypt, nearly 2,000 yr before the first U.S. lighthouse was established.

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